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CONTENTS.

ILLUSTRATED ARTICLES: PAGE.
Note on Secondary Generators 164
The Gaulard-Gibbs Secondary Generator 164
An Early Reference to Variable Contact Transmitters 164
Studying Earthquakes by Electricity (continued) ... 165
Telephonic Investigations (continued) 166
A Novel Electric Gas Lighter 167
A Novel Main Switch 167
A New Indicating Box Bell and Annunciator 167
The Short-Nesmith Electric Railway System 168
Long-Distance Distribution of Electric Energy 170

NEW BOOKS:
"A Century of Electricity." 164

CORRESPONDENCE:
"Interfield" 164
"Kinetic Field" 164
The Theory and Practice of Dynamo Construction 164
The Predetermination of the Characteristics of Dynamos 166

CORRESPONDENCE: PAGE.
Lighting Cars by Electricity—The Problem Solved .. 166

EDITORIAL PARAGRAPHS 163

MISCELLANEOUS:
"Creeping Joints" in Telegraph Lines 166
Obituary—Daniel Davis 166
Filing Electrical Patents for Reference 167
Re-organization of the Schuyler Company 169
Annual Meeting of the American Bell Telephone Company 170

DEPARTMENTS:
New York Notes 171
New England Notes 172
Philadelphia Notes 172
Western Notes 173
The Telegraph 173
The Telephone 173
The Electric Light 173
Applications of Power 174
Personals 174
Miscellaneous Notes 174
Business Notices 174
Our Illustrated Record of Electrical Patents 174

New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

PAGE.
The Vitrite & Luminoid Co.—Notice of Removal .. i
Electrical Supply Co.—Chromic Acid i
Olson Oil Co.—Tracy Patent Oil Filter ix
E. L. Morgan & Co.—The Special Telegraph Key ix
Eclipse Wind Engine Co.—Eclipse Friction Clutch x
W. J. Johnston.—New Book, "Practical Electricity" xii
Central Electric Co.—Electrical Supplies of all kinds xiv
Want and For Sale Advertisements ix

Vol. IX. NEW YORK, APRIL 2, 1887. No. 14

THE description, with illustrations, in this issue, of the electric railway at Denver, deserves study as being a practical attempt to operate a street railway on the series system. The plan adopted seems familiar in some respects, and its success is another argument for the universal employment of electricity in such work.

ON another page will be found the statistics for last year of the American Bell Telephone Company, presented at the meeting held this week in Boston. The company is in better financial shape than ever, and its earning capacity has suffered no diminution, the total number of exchange subscribers having increased 9,318, as against 2,969 in 1885, and the number of instruments in the hands of the licensees being 23,478 more than in 1885. The receipts or earnings were $3,097,000, as compared with $2,765,844 in 1885, and, unless an unfavorable decision is given in the United States Supreme Court, the results for 1887 will be a quarter of a million greater than those of 1886. These are striking figures. The statistics as to the daily number of connections are good evidence as to the firm grip the "telephone habit" has on this busy people. It will be noted that while the wire mileage has materially increased, the concentration of exchanges and branch offices still goes on.

THE continued throes of earthquake give timeliness to the discussions now going on in regard to the origin and effect of these disturbances. That great interest, in many quarters, is taken in the subject is evidenced by the demand for copies of the paper containing the articles we are now publishing on the study of earthquakes by electricity. The apparatus described in this week's installment is very ingenious, being the protoseismograph, devised by Prof. M. S. de Rossi, an Italian meteorologist of distinction. It may be mentioned, by the way, that the March *Scribner's Magazine* has an excellent article by Prof. Shaler on earthquakes.

WE print this week a brief communication from Mr. S. S. Wheeler in regard to the matter of a system of indorsing patents on such a portion of the outside pages as to render reference easy. To those who do not handle many patents, this may seem a small point to worry about, but those who are in the habit of going frequently through a number of patents, in a file or reference box, will see that Mr. Wheeler offers an admirable suggestion. Perhaps the best thing to do would be to present a petition to the Patent Commissioner on the subject. It would receive a great many signatures, and, probably, be acceded to. There is no reason why bunched patents should be more difficult to refer to than an equal number of leases or policies, or bills before Congress and the Legislatures.

IN a note discussing the losses encountered in the secondary generator or converter, Dr. Louis Duncan, of Johns Hopkins, points to a curious feature in which the dynamo is superior to the former. It is that the mechanical vibration experienced by the moving armature assists in the reversal or change of magnetism as it revolves between the pole pieces. In the stationary converter this jarring does not take place, and hence he assumes that its efficiency is somewhat diminished on that account. Dr. Duncan also points to the difference in the results obtained by Dr. Hopkinson and Professor Ferraris in their experiments on transformers, and is of the opinion that the results obtained by the latter are not correct, as they do not agree with the numerical calculations. The investigation is worth following up, in a number of details, and Dr. Duncan has probably mapped out already some very important work of the kind.

THE rapid march of improvement and invention in electricity and its applications has brought forth many new things, it is true, but there appears to be no telling what other new ideas may be lurking in the musty volumes of years ago. Our columns frequently contain communications from studious correspondents who delight in going over the work of the past and who frequently meet with descriptions of methods bearing close resemblance to others apparently novel brought to notice but yesterday. In this issue one of the finds of this type is mentioned, in which the change in resistance of an electrical circuit by change in pressure of a material included therein is shown to be over 25 years old. These instances, of course, do not in any sense detract from the merit due to more recent inventors, but they point to the fact that much can be gained by the study of old electrical literature of which there is more extant than most people are aware of.

NEW ORLEANS has taken a decidedly new departure in its ordinance authorizing and enforcing a complete system of towers for the support of wires. Disgusted with poles, and aware that underground systems would have a very poor chance in the swampy soil on which the city is built, the City Council has adopted the arrangement with which the name of Col. Flad, of St. Louis, has chiefly been identified, and which has found some measure of exemplification in the beautiful tower lighting at Detroit. Now, as we understand it, the 224 tall towers in New Orleans are to carry all the electric wires distributed through the city, each class having its specific location on the towers. This plan has many elements to recommend it, and its practical working in the Crescent City will be watched very closely and curiously. It is possible that other cities may want to try the same thing for themselves, on the basis of which our Western correspondent speaks in his notes.

THE care and attention with which our columns are read is well demonstrated by the discussions continually springing up and going on in them and by the numerous answers which questions submitted to our readers receive. Recently a problem, the determination of which required quite some power of analysis, brought out several correct solutions, and we also note that a correspondent, who disagreed with Mr. Gisbert Kapp in regard to a formula involving the predetermination of the characteristic of the dynamo, was set right by two of our correspondents. Distance alone prevented Mr. Kapp's reply from appearing simultaneously with the others, but we give elsewhere his own answer to the objection raised to the correctness of his formula. It is identical with those already printed, and shows that his work is carefully considered in this country, as it deserves to be. Mr. Kapp has done much to "popularize" dynamo construction—if we may be allowed to use that term—and his excellent machines are the best proof of the correctness of his theory and method of designing.

THE change in apparatus and in manner of working necessitated by the use of alternating current machines in connection with converters, in electrical distribution, has naturally set inventors on the path of devising means for adapting the continuous current machine to the same method of distribution. The application of simple devices can change a continuous current to one of an alternating character, so that there may thus be obtained two kinds of current from the same machine. The objection raised to a system which does not at present furnish a current suitable for motor purposes is thus removed. In another column Mr. Pfannkuche describes his own system of distribution of this nature, in which the dynamo of the continuous current type is arranged to give both kinds of current. On the plan described there ought, it would seem, to be no difficulty in distributing currents for any purpose needed. Indeed, it has been remarked before that the time has come when electric light companies must be prepared to cater to *all* the current wants of the public. We see the first efforts in this direction in the spread of the practice of placing incandescent lamps and motors on arc circuits. Hence, if the alternating current should become a regular feature in electric lighting, as we expect it will, some method by which it can be readily obtained and regulated is of considerable importance.

AN inspection of the electric lights of Nashville was ordered recently by the city council of that city, and the special committee made a "scientific test." They found that the lamps in use, known to the trade as "2,000-candle power" lights, "varied from 690.73 to 1,512.88-candle power, with an average of 999.105 candles." Here is accuracy and minuteness to suit the taste of the most fastidious alderman. How sad and strange it is to think that the lamps came just within 895 thousandths of averaging 1,000 candle-power. The investigating committee compares its results with those obtained at the Electrical Exhibition in 1884. But the Philadelphia tests can evidently not compare in delicacy or refinement of apparatus with those of the Nashville scientists. We see direct proof of this in the fact that in the Franklin Institute tests not a single instance occurs in which the candle power of a lamp is given with a fractional addition, all the results being in whole numbers. Now that we look back upon the Franklin Institute tests, in comparison with these, we see how utterly crude the apparatus must have been with which they were made. The Nashville scientists, on the contrary, take their fine measurements out in the open air in a spanking breeze, and get their readings down to the thousandths of a candle power with ease and certainty. The New South is evidently making rapid headway in methods of physical research, and the new photometer of such extraordinary delicacy and reliability is probably the forerunner of many other instruments of precision from that part of the country. To be more serious, however, while we are heartily glad to see these tests made, we ask, is it not "going it a leetle strong" to put in the thousandths?

THE lively and interesting discussion on pole pieces and dynamo construction which has been going on in our columns for some time seems to be drifting from the point of starting. The question involved is one of some importance, and that is the reason we have devoted the space allotted to it with pleasure. Those who have discussed the question, however, have not fully brought out the fact that the efficacy of pole pieces largely depends upon another function, viz.: the amount of iron in the armature We are, in fact, brought back to the recent investigations of Hopkinson and Kapp, in which the magnetic circuit is treated in the same way as the electric circuit. It is easy to conceive that if the armature contains sufficient iron to carry all the lines of force emanating from the field magnets, the latter may be supplied with pole pieces which may embrace the armature to even a very considerable extent without causing leakage of lines across from pole to pole. But if, on the contrary, the armature does not contain sufficient iron to carry the lines of force, the air space between the ends of the pole pieces will present a relatively less magnetic resistance, and a far greater leakage of lines of force will take place. So that if the latter is to be avoided, the distance between the ends of pole pieces must then be increased. In other words, the pole piece must be diminished or suppressed entirely. Thus a machine having an armature deficient in iron would, in all probability, be more efficient without pole pieces; while with plenty of iron in the armature, the pole pieces may be enlarged so as to almost completely embrace the armature, and without serious magnetic leakage across the ends. These principles of construction have been borne out by actual experiment, and we call attention to them, as they may serve as points of new departures for the contributors to the controversy.

NEW BOOKS.

A CENTURY OF ELECTRICITY. By T. C. Mendenhall. Boston. Houghton, Mifflin & Company. 1887. 225 pp. Illustrated. 5 × 7. Price, $1.25.

Dating back to the work of Galvani, Prof. T. C. Mendenhall has given in this volume a review of what has been accomplished in electricity since 1786. The book is avowedly popular in aim and treatment, and will stand well to the front among productions of its class. As we have before remarked, it is by no means easy to write upon such a comprehensive subject in a manner that, while doing justice to all the facts and principles, will enlighten the ordinary reader rather than confuse him with multiplicity of detail and tire him with abstruseness of terminology. Prof. Mendenhall, whose scientific qualifications are known to all, has, in this work, shown himself equal to the difficult task of seizing upon fundamental ideas and main lines of invention and treating them in a series of interesting and instructive chapters. His style is clear, his choice of words admirable, and his sense of proportion delicately fine. The student or beginner who brings to the perusal of this suggestive book a thirst for information and an appreciative intelligence, will find himself eager for further acquisition of knowledge and greatly helped on his way.

Note on Secondary Generators.

BY DR. LOUIS DUNCAN, JOHNS HOPKINS UNIVERSITY.

Consider a secondary generator, as in the accompanying figure. Let A and B be the terminals of the primary, C and D those of the secondary.

The losses between these points due to the introduction of the apparatus are :

1. Loss due to heating of primary coil by the current. If the current follows a sine curve and C_o is its greatest

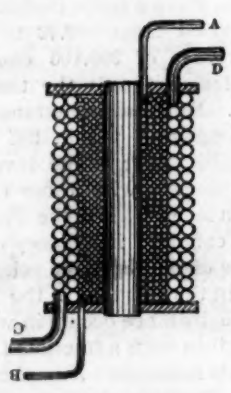


DIAGRAM OF GENERATOR COIL.

value; R equal the resistance of the primary, then the loss in the primary will be :

$$L_p = \tfrac{1}{2} C_o^2 R.$$

2. Loss due to heating of secondary coil by current :

$$L_s = \tfrac{1}{2} C'^2_o R'$$

3. Loss due to currents induced in the mass of the iron. This is at any instant :

$$L_i = \mathfrak{M} \left[\frac{d \mathfrak{B}}{d t} \right]^2$$

where $\mathfrak{M}$ depends on the material of construction of the core.

4. Loss due to the reversal of magnetism in the core :

$$L_r = \tfrac{1}{2} \pi \int \mathfrak{B} \, d \mathfrak{H},$$

where $\mathfrak{B}$ is the magnetic induction and $\mathfrak{H}$ the magnetic force.

5. Slight loss caused by thermo-magnetic properties of the iron.

Of these (1) and (2) are well known and can be made small by making the corresponding circuits of little resistance. (3), due to so called Foucault currents, can be reduced by laminating the core.

The loss appearing under (4) depends upon the retentiveness of the iron, and under certain conditions can assume large values. It is possible, as Dr. Hopkinson has shown, that the loss in a steel armature of a dynamo, from this cause, could be 20 per cent.; for a wrought-iron armature it might be 4 per cent., providing there was no vibration ; there is a vibration in a dynamo at work, so it would be less.

But, considering this source of loss, a secondary generator labors under the disadvantage, when compared with an ordinary dynamo, that not only a part, but all of its mass is subject to reversals of magnetism and it suffers no vibrations. As for the value of (4) then, I suppose (in the absence of data regarding current, reversals, dimensions of coils and core, etc.) that it is considerable as compared with the other losses. This loss is smallest when the core does not approach saturation and when it is made of very soft iron.

The loss under (5) is probably very small, and we need not consider it further.

All of these losses appear as heat in the secondary generator, and if proper precautions were taken they could be measured as such, and the efficiency of the system, calculated in this way, could be used as a check on the ordinary methods of measurement, which are very difficult to make accurately.

Of the experiments made on the efficiency of such generators, the value given by Dr. Hopkinson, *i. e.*, 86.1 per cent., is probably quite near the actual value. The "commercial efficiency," given as 95 per cent. by Prof. Ferraris, either means something else than is usually meant by that term (probably total efficiency of conversion), or is the result of miscalculation, as it does not agree with the tables given.

The Gaulard-Gibbs Secondary Generator.

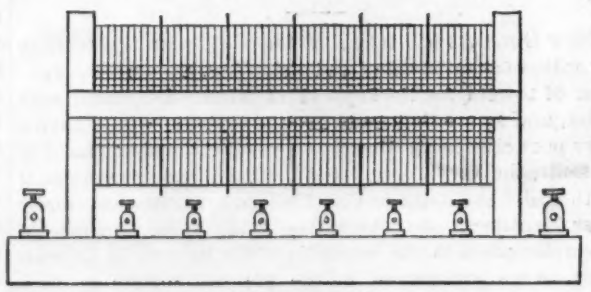
BY AUGUST PARTZ.

In a discourse on the "secondary generator" of Gaulard and Gibbs, at the recent meeting in Philadelphia of the National Electric Light Association, Dr. Moses stated that in 1882 Lucien Gaulard, of France, made an apparatus in which a primary current of high electromotive force and small quantity, passing through a fine wire, was transformed into a secondary current of low electromotive force and large quantity by induction in a thick wire. This is indeed the opinion generally held on the subject. But it appears that at the end of 1883 Gaulard himself yet claimed his device to be something quite different from what Dr. Moses said it was, and from what it was even then already thought to be, and now really is ; and since the invention has become an object of industrial importance and financial interest, it may be well to see in what it originally consisted and how it came to be changed.

In a critique of the Gaulard-Gibbs system in *La Lumière Électrique* of Dec. 15, 1883, Frank Geraldy maintained that it amounted simply to a reversion of the Ruhmkorff coil, and had already been proposed and presumably applied by Fuller, of New York, who died in 1879.

Replying to Geraldy in the same journal of Dec. 29, Lucien Gaulard tells him that he is entirely mistaken, and, with reference to a photograph which he had sent to him, says : "The 'secondary generator' is, as the figure shows, composed of 16 vertical columns placed parallel with each other between two boards held in position by iron bolts. Each column is formed of a coil of copper wire 4 millimetres thick, surrounded by coils of 48 wires ½ millimetre thick, which are joined in 6 groups of 8 wires each. All the wires are singly insulated by a double coating of paraffined cotton, and the separate groups (cables) of fine wire again enveloped in the same material. It is the wire of 4 millimetres, and consequently of least resistance, in which the primary current circulates, while the different groups of fine wire receive the secondary current." Gaulard then refers to his and his partner's achievements in England, and, after remarking that they "place at the disposition of consumers such currents as suit their purpose," and "furnish for each lamp, according to its resistance, the number of volts and ampères it may require," he says : "The advantage of the interposition of secondary generators in cases of distribution of force is beyond dispute, for as the movement of the motor is synchronous with the alternations of the primary current, the force developed by the motor will be regulated by the secondary generator, and therewith the light."

In an appended rejoinder, Geraldy gives a copy of the



SECTION OF EARLY GAULARD-GIBBS SECONDARY COIL.

drawing, shown in the accompanying illustration, attached to the French Gaulard-Gibbs patent of Oct. 7, 1882, and writes substantially : "I presume it will not be denied that this is really and verily an induction coil of the Ruhmkorff type. The arrangement has since been changed, but what has been adopted is far from being new ; it has, besides other modifications, been made in Ruhmkorff's shops and will, for instance, be found described in *Les Mondes* of Oct. 24, 1878, as applied to an apparatus made for Professor Stroumbo ; and if MM. Gaulard and Gibbs think they have done something new by placing their coils in a vertical position, they are mistaken, since that has quite often been done in Germany. I always thought that those gentlemen intended by their system to send a current of small quantity and high tension through a comparatively fine wire, so as to diminish the loss upon the line, and to transmit to the lamps or motors a current of greater quantity and minor tension. And that is what has been clearly stated in the journals," etc.

La Lumière Electrique of Jan. 12, 1884, contains a second letter from Gaulard, in which he complains of unfairness on the part of Geraldy, and tells him if he had carefully studied the articles on the Gaulard-Gibbs system in some English journals, he would have seen that "the sum total of the sections of the induction wires (*des induits*, secondaries) is less, by three millimetres, than the section of the inductor (*de l'inducteur*, primary) and that each column of the secondary generator, traversed by a primary current of 2,000 volts, brings forth a secondary current of 25 volts." After this Geraldy declined to continue the controversy.

The above synopsis of the wordy and somewhat discursive statements and argumentations of both contestants will suffice to give an idea of the evolution through which the Gaulard-Gibbs converter has passed, and which leads one to ask the question, Who really invented the apparatus in its present state?

An Early Reference to Variable Contact Transmitters.

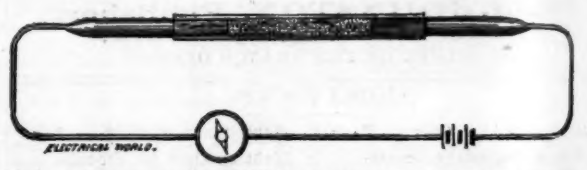
BY A. M. TANNER.

In my researches concerning electrical inventions, I discovered what may be considered the forerunner of the Clerac rheostat and the tension regulator of the modern telephone transmitter.

In *Poggendorf's Annalen*, Vol. III., for the year 1860, appears an article by Beetz, on the electrical conductivity of different bodies. The article states that platinum sponge is closely packed in a narrow tube, and that conducting wires are passed into the ends of said tube. These wires are movable, so that when they are pressed together the galvanometer shows an increase of current. The accompanying sketch shows the idea.

It is evident that Beetz gives the results of practical experiments, and he even goes on to say that the conductivity of the platinum sponge is increased when heated, and that the latter effect is produced when the wires are pressed together.

I do not remember ever having seen any mention made



BEETZ'S EXPERIMENT WITH VARIABLE CONTACT MATERIAL.

of the Beetz experiments in connection with the history of the variable contact transmitter, Du Moncel and Clerac only being mentioned, as having first advanced the theory of "change of electrical conductivity by variation of pressure."

"Interfield."

To the Editor of The Electrical World :

SIR : I would suggest the word *Interfield* as a suitable word to designate the space referred to in your recent editorial. M. DINGS.

March 19, 1887.

"Kinetic Field."

To the Editor of The Electrical World :

SIR : I see in the editorial page of the last issue of THE ELECTRICAL WORLD a call for a name to be given to the space between the inner face of the field magnet and the outer face of the armature magnet. Why would not the term "Kinetic Field" properly express it? "Field" suggests space, and "Kinetic" denotes active energy, thus field of active energy. It would, it seems to me, cover the ground, and make a term that would be readily understood as embracing both the space occupied by the wire of the armature and the clearance space between it and the field magnet. W. S. HILL.

BOSTON, Mass.

The Theory and Practice of Dynamo Construction.

To the Editor of The Electrical World :

SIR : As regards the statements made by Mr. Watts in THE ELECTRICAL WORLD of March 19, I would like to advise him to carefully read over again the remarks made in the article on "Dynamo Construction and Pole Pieces," Feb. 5. He will then see that I did not speak of the origin of the curve, but of the knee. A glance at the most prominent dynamos (Edison's, commercial efficiency, 90 per cent. ; Weston's, 90 per cent. ; Crompton's, Kapp's, Schuckert's, Siemens') will also show him whether I was theorizing or speaking of a principle which is the outcome of practical experience. As regards the antiquity of theories, all I can say is, that, as they were given by Thompson and Kapp, and some of them no further back than the fall of the year 1886 (see the references given in the article in THE ELECTRICAL WORLD, Feb. 5, 1887). I can only regret that such eminent scientists and practical electricians should have wasted so much time in fruitless researches, for such I suppose they must be termed, as they denote, according to Mr. Watts, no progress since 1883-1884. W. M. S.

PHILADELHPIA, Pa.

Studying Earthquakes by Electricity.

(*Continued from page* 152.)

It will be noticed that in every case the apparatus so far described requires to be reset after each disturbance. Since it so often happens that seismic disturbances recur several times in a brief interval of time, the vigilance of the attendants is apt to be severely tried, and, as usual, to be sometimes found wanting. These facts have led to the construction of apparatus requiring no readjustment after each disturbance and to the use in connection with these of automatic time registering apparatus. The apparatus shown in Fig. 15 is known as the protoseismograph, and is the invention of Prof. M. S. de Rossi, an Italian meteorologist of distinction. The framework of the apparatus consists of a rigid iron structure secured to a massive base of iron, which rests on a solid foundation and pedestal of masonry, being secured by means of four strong bolts in the lugs at the corners of the base-plate. The structure is made up of four tapering cast-iron beams or standards, having a cross section of the form of the letter T. The wider ends or bases of these standards are bolted to the iron base-plate, while the upper ends are surmounted and girdled by a cast-iron circle securely fastened by bolts. Resting upon this iron crown and secured to it is a wrought-iron cross, which supports an upright brass tube *a* over the centre of the circle. The weight *P* is suspended in the centre of the apparatus by a wire one-half millimetre in diameter, the upper end of which reaches up into the tube *a* where it is attached to the tip of the screw *v*. The weight, which is of three kilogrammes, constitutes a pendulum when thus suspended; and as the centre of gravity of this pendulum is adjusted so as to be at 99 cm. from the point of suspension, it follows that the period of oscillation or the beat of the pendulum will be about one second.

On each side of the base-plate, half-way between the bolt lugs, there is a brass bracket, which is screwed to the base-plate. Each of the four brackets supports a mercury cup arrangement similar to that used in forms of apparatus adapted for subsultory phenomena. The outer ends of these brackets project outwardly to such a distance that the centre of the mercury cups shall be equidistant from the wire supporting the pendulum weight *P* (*i. e.*, the centre of the apparatus) and the brass columns *C C′ C″ C‴* which are supported on these four brackets, but insulated from them by ebony bushings. Each column holds a bent wire arm that is directed inward so as to have its extremity stand about 10 or 12 cm. above the mercury cup. Immediately above the surface of the mercury and almost in contact with it is a delicate platinum needle. In the figure this needle is replaced by platinum tipped weights, similar to those used in the forms of apparatus previously described.

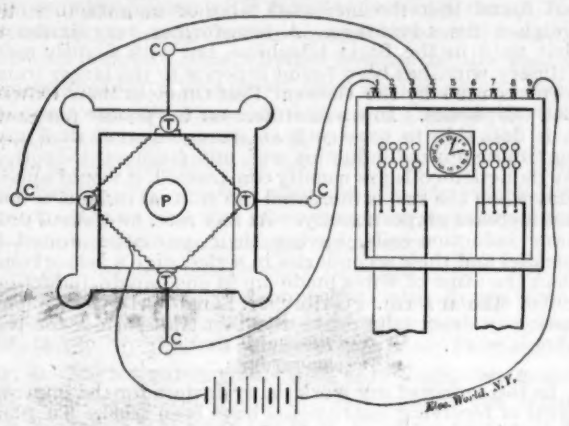
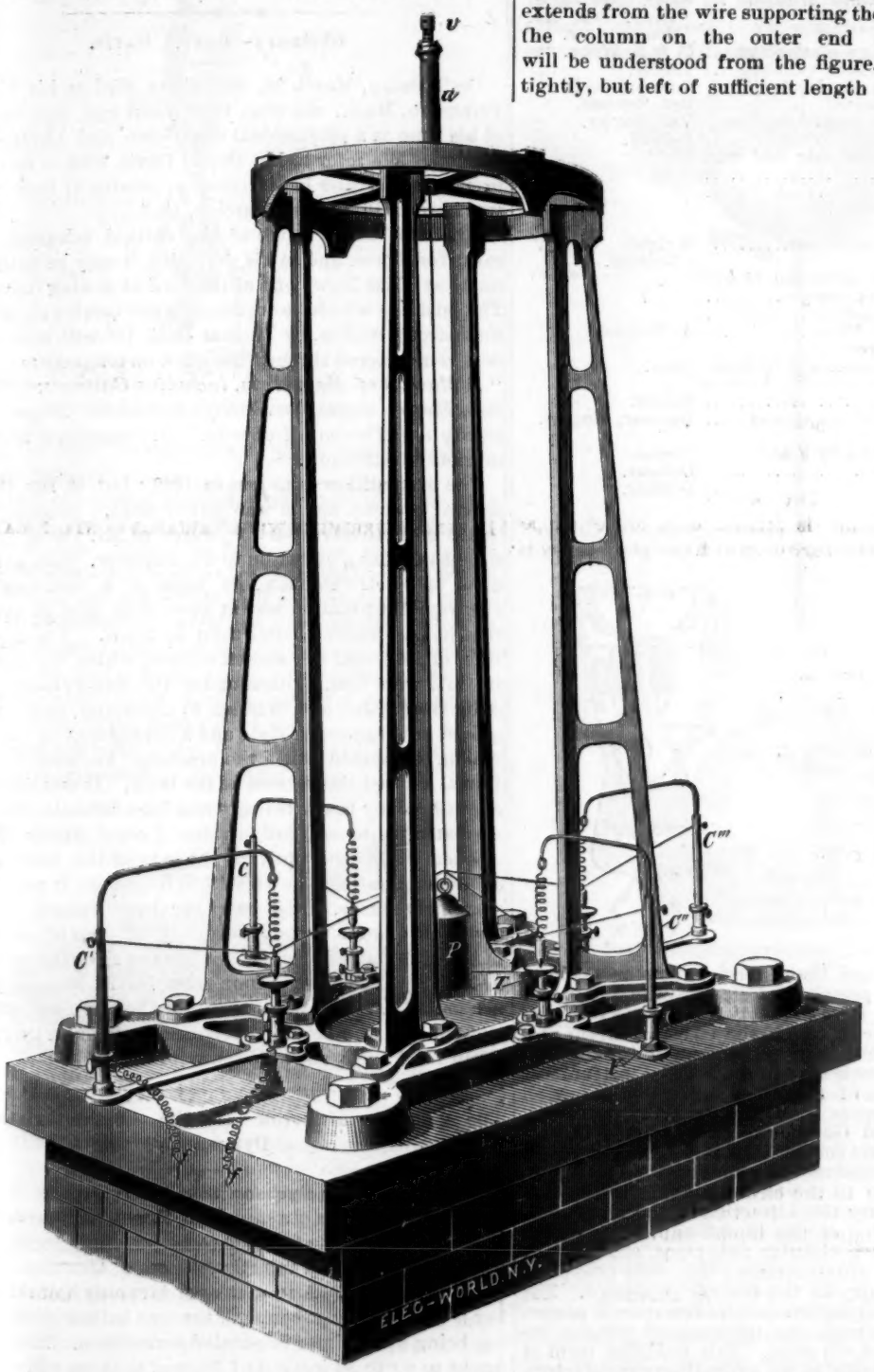
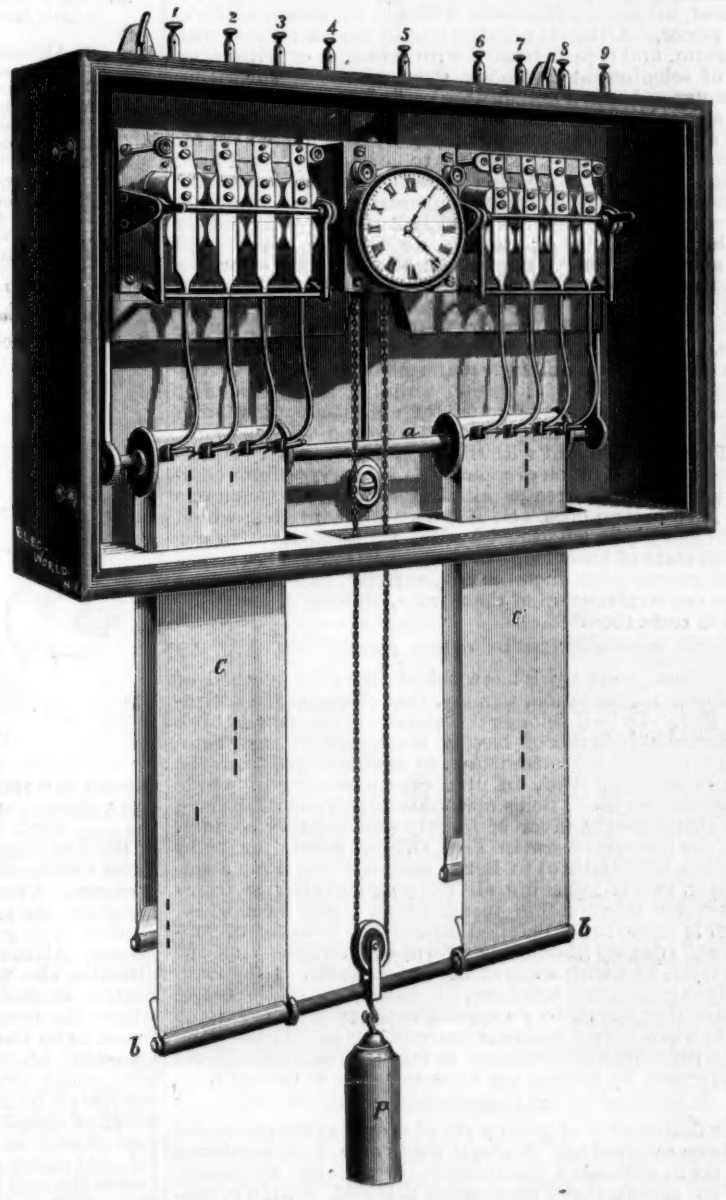


FIG. 16.

In reality, however, it is made of a fine piece of platinum and is light enough to be suspended on a single fibre of cocoon silk that is threaded through its eye. This silk fibre extends from the wire supporting the pendulum weight to the column on the outer end of the bracket, as will be understood from the figure. It is not stretched tightly, but left of sufficient length so that the weight of the platinum needle makes it form an angle of about 160°. The wire spring extending from this needle to the curved arm above does not serve to uphold the needle as was the case in the apparatus for subsultory shocks. Its sole function is to maintain the electrical connection between the needle and the brass column which forms one terminal of the circuit. This spring is therefore made exceedingly light and delicate, so that it may oppose no resistance to the movement of the needle when the silk fibre is stretched or slackened. From the diagram of connections (Fig. 16) it will be seen that each one of the four brass columns *C C′ C″ C‴* is connected by a separate wire with one of the electro-magnets of the registering clock (Fig 17); while the four mercury cups *T T T T*, which are electrically connected together by the base of the apparatus, are connected to the common return circuit in which the battery is also included. The registering apparatus (Fig. 17) is contained in a wooden case with a glass door. The clock is an accurate time-piece of the pendulum variety, and operated by a weight *P*, as shown. This weight is fastened to a cross-arm *b b*, which pulls down the two paper strips *C C* that are clamped to it, one on each side. These paper strips wind over two drums, mounted on the same axis *a*, and they are kept tense by a counterweight fastened to each strip at the other end. The clock movement is so co-ordinated that the weight falls a distance of exactly four centimetres per hour. Consequently each four centimetres length of the strip represents an hour, or each centimetre one quarter hour and the strip may be ruled beforehand into any division of time desired.

Each paper strip corresponds with a set of four registering pens, each of which is attached to the lower end of the armature lever of an electro-magnet. The point of the pen is normally held by the armature spring at a short distance from the surface of the paper; but when the circuit is closed through any one electro-magnet the corresponding pen is brought into contact with the paper, leaving a dot which will be prolonged into a dash if the armature remains attracted by the continuance of the current, because of the motion of the paper strip. The protoseismograph is usually so placed that the four mercury cups correspond with the four main points of the compass. These cups are normally adjusted so as to bring the surface of the mercury as near contact with the platinum needle as possible. Now the slightest undulatory pulse will cause the weight to swing in the direction from which that impulse came. Supposing the impulse to be from the left, the weight begins to swing to the left; but the least deviation of this weight from its central position must slacken the silk fibre extending between its supporting wire and the column *C′*, while it will tighten the fibre attached to *C‴* on the other side. With the silk fibre forming an angle of 160° the motion of the pendulum is amplified about three times at the platinum needle, consequently the platinum needle on this side will soon dip into the mercury and close the circuit through the corresponding electro-magnet at the registering clock. On the return swing of the pendulum the opposite needle will dip and cause a dot to be recorded on the paper strip, but a little behind the first. If the disturbance follows a direction which is not parallel with any of the silk fibres, then it will readily e apparent that two of the platinum





FIGS. 15 AND 17.—STUDYING EARTHQUAKES BY ELECTRICITY.

needles will dip at the first swing and two at the return swing. If the direction is half way between any two needles (say northeast), then the two needles toward which the pendulum moves will dip simultaneously and the opposites will do the same on the return movement; but if the direction is not half way, say northeast by east, one of the pair will precede the other in such case by a slight interval of time; and on the strip of paper it will be found that although the "north" and "east" form the first pair of dots, the dot corresponding to the circuit of the "east" mercury contact is a trifle ahead of the "north" dot. Of course, the faster the movement of the paper strip the more apparent would this difference be. In practice, however, it is sufficent to determine the general direction which the impulse followed, and the record of the two dots, "north" and "east," followed by the dots "south" and "west," due to the return swing of the weight would be interpreted as indicating a disturbance proceeding from a northeasterly direction.

(To be continued.)

Telephonic Investigations.*

BY PROF. SILVANUS P. THOMPSON, D.SC.

(*Continued from page* 147.)

MATERIALS FOR TRANSMITTERS.

Much time has been expended by me in endeavoring to find a pair of materials which, when used as the contact-surfaces of a transmitter, should give better results than the ordinary contact of platinum against carbon. Contacts if made in both parts of metal are somewhat uncertain in action, chiefly because of the deterioration of surface. I have also examined many of the substances, natural and artificial, which possess quasi-metallic conductivity. Some of these form excellent materials, but each has its own particular qualities. Among natural minerals I have tried the following: Native arsenic, mispickel, ilmenite, allemontite, specular iron ore (black crystals), magnetite, micaceous iron, cloanthite, pentlandite, clausthalite, redruthite, chalcopyrites, smaltine, and pyrolusite. Some of these were better than others; but the best, micaceous iron, was difficult to obtain in workable pieces. Artificial preparations of copper treated with tellurium, and copper treated with selenium or with mixtures of selenium and sulphur, gave results of surprising character. A hard and brittle sort of bronze formed in this way takes a brilliant polish like steel, and yields, when used against a platinum point, an articulation which for crispness far surpasses anything to be obtained from hard carbon. At one time this bronze was used for the valve-pieces of the valve-transmitter, but although the articulation when the ball-valve was newly polished left nothing to be desired, it was found to acquire from the moisture of the air a film, probably of selenic acid, at the contacts, which gave rise to curious, shrill whistling sounds. Mr. G. L. Anders has made excellent transmitters of osmium and of palladium. Nickel also answers fairly well. There is a great difference between different materials with respect to the range of amplitude of vibrations suitable for them. For the metals in general the range of amplitude of motion must be very small; they require almost rigid connections. With hard carbon and with the copper-selenium composition the range is much greater. The copper-selenium composition requires a greater initial pressure at the contacts than hard carbon does. So also does chalcopyrites, which has recently been suggested by Mr. P. Rabbidge. In our present state of knowledge of the properties of those bodies which possess quasi-metallic conductivity, it is difficult to frame any explanation of these facts, or draw a useful deduction from them.

TRANSMITTERS ON OTHER PRINCIPLES.

Incidentally my work has touched one other method of telephonic transmission, namely, that originated by Graham Bell. To Bell belongs the unquestioned, and I think unquestionable honor of having suggested the magneto-electric method of transmitting, as distinguished from the contact method. But, in nine cases out of ten, where telephones are used, Bell's method is not employed, having been abandoned in favor of battery and variable contact. Even the Imperial German Post Office, which for eight years has been faithful to Bell's method, has now abandoned it, and is replacing all its magneto-electric transmitters by microphonic transmitters. My own work, which is more fully detailed under the heading of "receivers," consists in devising a form of instrument on the principles, and with some of the actual parts, of the modern dynamo-electric machine. I have also succeeded in transmitting speech by an apparatus the principle of which was to use a nearly constant current, but to vary the number of times that it circulated around the primary of the transformer, by cutting out more or fewer of the coils.

TRANSFORMERS.

The desirability of getting rid of sparks at the electrodes has been referred to. A shunt made of a thin resistance wire (as in Johnson's transmitter), or a liquid resistance, does not satisfactorily accomplish this end, though it mitigates the evil. I have found that the best method is to use a differentially wound transformer. My coadjutor, Mr. Jolin, had found, when experimenting on an electric meter, that a double differential winding on an electromagnet enabled him to open and close the circuit without any appreciable spark, even when using very strong currents. On suggesting to him that a similar device might be applied to the primary coils of the transformer, the transmitter being placed in one branch, he constructed one, but found it expedient to add a balancing resistance in the other branch. The arrangement is shown in Fig. 8, in which the system of circuits is shown. The primary circuit is shown in dotted lines, dividing at *A*; the valve transmitter *V* being in one primary, and a thin German silver wire *W* as a resistance in the other. The secondary coil is in parallel with the receiver. The electromagnet shown at *M* relates not to the transmitting circuit at all, but to a peculiar arrangement of receiving circuits, in which an electro-magnet (that of call-bell) is used as an induction plug. It may be remarked in passing that this differential method of working is applicable to other transmitters; in particular, with sensitively adjusted transmitters, to which one must not speak too loud, and which are affected by vibration of buildings, the articulation is immensely improved by its use. Even the Blake works excellently amongst the machinery of a factory when provided with one of the differential transformers. The "Valve" telephones are all provided with them. You may shout as loud as you please to these instruments without producing any unpleasant rattling sound. We also constructed transformers having closed magnetic circuits, but found that the increased labor of manufacture outweighed the advantage. A transformer very similar to that used in the Blake telephone, but with slightly more primary wire, has been found superior to the larger transformers used by the General Post Office in their Gower-Bell telephones. In transformers for telephonic purposes, it is desirable to have such an arrangement as shall give maximum mutual induction with minimum self-induction. As induction-coils are usually constructed, it would appear that when the size is increased the mutual induction does not increase proportionally. At any rate, two small ordinary induction-coils, having their primaries united in parallel and their secondaries in series, give a better result than the same of wires made up in one single induction-coil of similar form. Possibly Mr. Langdon-Davies's phonopore may eventually prove the best transformer for telephonic work.

RECEIVERS.

In the course of my work many devices for the improvement of receiving instruments have been tried. To place the subject in a clearer light, I here append a systematic table of the various classes and genera of receiving instruments.

CLASSIFICATION OF RECEIVERS.

I.	*Electro-Magnetic Force.*	
	1. Magnetic expansion	Reis.
	2. Electro-magnet with armature	Reis, Yeates, Varley, Gray, Bell, Macdonough, etc.
	3. Two electro-magnets attracting	C. & L. Wray.
	4. Electro-magnet itself vibrating	Theiler.
	5. Electro-magnet altering friction	Dolbear, Cooke.
	6. Solenoid and magnet	Bell, Siemens.
	7. Two coils attracting or repelling	Vail, Taylor.
	8. Deflexion of needle by coil	Bidwell.
	9. Pivoted armature near field magnet	
	10. Magnetic repulsion	
	11. Two parallel wires	
II.	*Electrostatic Force.*	
	1. Air condenser attraction	Wright, Varley, Dolbear.
	2. Air-sound from alteration of surface-density of charge	?
	3. Electrostatic repulsion	
III.	*Electro-Capillary Force*	A. Breguet.
IV.	*Tribo-Electric Force.*	
	1. Physiological (increase of friction)	Gray.
	2. Moist chalk against metal (decrease of friction)	Edison.
V.	*Microphonic Contact Repulsion*	Berliner, Hughes.
VI.	*Thermal Expansion.*	
	1. Expansion of wire by heat	Preece.
	2. Glow-lamp	Dolbear.
VII.	*Crookes' Tube*	Dolbear.
VIII.	*Crookes' Layer*	

With the exception of the discovery that a Crookes' layer between a "spheroidal" drop and the plate below it

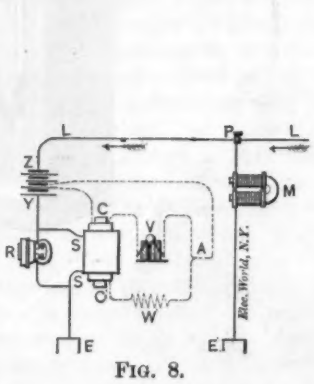


FIG. 8.

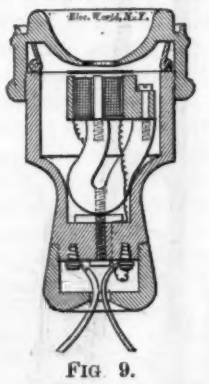


FIG. 9.

can act as a receiver, and that a receiver can be made to work (feebly) on the principle of electrostatic repulsion, the only work that I have to mention relates to receivers of the first class—those in which the electric current produces the motion by means of the magnetic force which it exerts. Upon the table here I have several instruments based on the principle of magnetic expansion. They all require stronger currents than the ordinary receivers. Messrs. Alabaster and Gatehouse have worked in this direction also with some success. Next I exhibit a modification of Bell's membrane electro-magnetic receiver, in which the form given to the electro-magnet is the one found to be the best for the attraction of the small disc-armature, about the size of the thumb-nail. The coil is surrounded (Fig. 9) by a circular pole-piece, cut away at one point to hinder eddy-currents; this outer pole-piece being of opposite polarity to the central pole-piece. The pull of such an electro-magnet upon its armature is powerful, and varies greatly with the thickness of the gap between the iron disc and the poles. This modified form of the membraneous receiver is an exceedingly satisfactory instrument. Its magnetism requires to be excited by a current while in use; but when used as I have been employing it, along with the "Valve" transmitter, it proves to be less sensitive to induction than most other instruments; and is, indeed, now in use on lines where, with other instruments, conversation was impossible, owing to the deluge of stray noises.

I have found that two iron wires stretched close together across a sounding-board, and traversed by the current, will answer as a receiver; but their natural note interferes with the tones of the voice. A receiver can also be made in which the working parts are two parallel iron cores which repel each other when similarly magnetized.

(To be continued.)

Legal Reports.—The *Patent Office Gazette* of March 15 contains in full the report of the proceedings in United States vs. American Bell Telephone Company in the Circuit Court of the Southern District of Ohio, Eastern Division; and the decision in favor of the company, as to want of jurisdiction. The whole occupies more than twelve pages of the *Gazette*.

* Read before the Society of Telegraph Engineers and Electricians Jan. 27, 1887.

"Creeping Joints" in Telegraph Lines.

BY J. B., JR.

A few days ago my attention was called to something that will, no doubt, interest the sceptics who laugh at C. C. Haskins' ideas of high insulation. A friend of mine, manager of a telegraph office, invited me into his office, with this remark: "We have trouble on one of our lines, which our linemen cannot find, and it puzzles me. You see it does not act like a swinging contact, because it closes the line instead of opening out." He touched the key several times, and showed the action described.

I divined the secret at once, and told him that it was a "creeping joint," and that the trouble only occured when the wind blew hard. Also, that it was at a place where a lineman would not be likely to look for it. The "joint" is a regular lineman's joint, made in a hurry, not soldered, often wound with a rag, and acts as follows: In the course of time, wires oxidize between loosely made spirals of joint. When the wind blows hard, the motion of the wire causes the parts of the joint to slide upon each other and to bring in contact the oxidized portions of the joint. This increases the resistance and causes the trouble observed. If it blows hard long enough, the joint will wear bright and be all right until electrolysis and rain re-oxidize the joint.

The lineman was sent to a bridge where such a joint as I have described was likely to be, and there it was found and repaired.

Obituary—Daniel Davis.

On Tuesday, March 22, 1887, there died on his farm, at Princeton, Mass., one who, forty years ago, was far ahead of his time as a professional electrician and electro-mechanician. We refer to Mr. Daniel Davis, long a manufacturer of and dealer in electrical apparatus at Boston. He was born in Princeton, March 8, 1813.

Mr. Davis made much of the earliest telegraph apparatus for Morse, and in his shop also, it may be noted, was made by Elias Howe one of the earliest sewing machines. The business which he organized is still carried on in Bromfield street, Boston, by Thomas Hall. He will, however, be best remembered through his work on magnetism entitled "*A Manual of Magnetism, including Galvanism, Magnetism, Electro-Magnetism, Electro-Dynamics, Magneto-Electricity and Thermo-Electricity.*" It contained about 180 original illustrations.

The first edition came out in 1842; but it ran through several editions, and is now out of print. Originally published more to advertise the wares of Mr. Davis, and as a means of calling attention to his business, than as a text-book of electro-technics, its value as a vade-mecum of electrical information was at once seen and it appeared that he had builded better than he knew. The first edition of 1842, and the second edition, which was published in 1847, were both written under the supervision of Drs. John Bacon, Jr., and William F. Channing, and hence acquired an elegance of style and a perspicuity of language, which, combined with the practical knowledge of Mr. Davis, assured the success of the book. It was adopted as a text-book by many colleges and high schools, becoming a great favorite especially in the United States Military Academy at West Point, for the sake of the many practical demonstrations shown within its pages. It has become extremely scarce, but it has ever been valued by those fortunate enough to possess a copy of it, and even now many of our ablest electricians are not ashamed to confess that they have learned much from Davis' *Manual of Magnetism*. Mr. Davis was a friend of Charles Grafton Page, and made a number of experiments with him up to 1839, when Dr. Page went to Washington.

The Predetermination of the Characteristics of Dynamos.

To the Editor of The Electrical World:

SIR: In reply to a question by F. S. in your issue of March 5, the mistake made by your correspondent consists in his having assumed that the *Nt* coils on a Gramme ring are coupled in series. As a matter of fact only half that number is at any time so coupled, the two halves of the winding being at all times in parallel connection. Hence F. S. ought to write $\frac{Nt}{2}$ instead of *Nt*, and then he will find the formula $E_a = Z_1 \frac{Nt}{2} u\, 10^{-6}$, as given in my paper read in 1885 before the Institution of Civil Engineers.

GISBERT KAPP.

WIMBLEDON, Eng., March 16, 1887.

Lighting Cars by Electricity—The Problem Solved.

To the Editor of The Electrical World:

SIR: Your editorial on this subject in your issue of March 19, together with Lieutenant Murdock's article, suggests a system of storage by compressed air by which the momentum of down grades and stoppages might be utilized to run small dynamos, and then putting on brakes becomes putting on air pumps. An iron reservoir with air motor and an automatic arrangement to connect and disconnect to the axle—and the thing is done!

G. D. BURBANK.

A Novel Electric Gas Lighter.

Electricity is to-day not only doing much to meet the general demand for light and power, but is being applied to an endless variety of domestic needs and uses. Of one of its recent applications, coming into the category of conveniences, we give an illustration on this page. It is well known that the friction match is still anything but what it should be; fires amounting to millions of dollars in damage occur every year through its employment, and a great many deaths must also annually be attributed to its careless handling. Besides matches are not always to be found when wanted, and when found will not strike. In many houses and stores, moreover, to light a number of gas jets, especially if they are high, it is necessary to supplement the match with wax tapers, involving additional expense and trouble. Here the electric gas lighter comes into play, and the cut we give is a view of the lighter

NEW ELECTRIC GAS-LIGHTER.

made by the New York Electric Brush & Ozone Company, under the Culp patents.

It consists of a metal framework, pivoted to which is a metallic disc, on the under side of which is attached a sheet of tin-foil. This disc rests against a flat rubber frame, on the other side of which is a metallic disc, which connects with the metal rods, and from the rubber frame runs a rod of rubber between the two metallic rods. In one of the metallic rods, at the top, is placed a small screw, which is adjusted so as to project toward the rubber rod, and come within about $\frac{1}{8}$ of an inch of a metallic point placed opposite in the hard rubber rod.

By raising the tinfoil disc from the hard rubber disc, electricity is immediately generated, and a spark is at

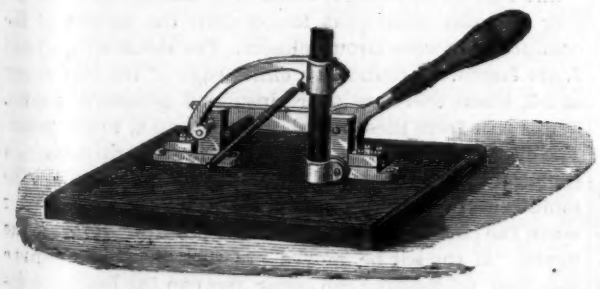


FIG. 1.—NON-SPARKING SWITCH.

once formed between the end of the brass screw in the rod and the metallic point in the hard rubber rod. Just as often as the metallic disc is brought in contact with the rubber disc and separated, just so often will a spark be generated, and each spark is capable of lighting the gas. The great advantage of this extremely simple form of apparatus arises from the fact that a spark will always be generated in wet or dry weather. By an occasional momentary chafing of the rubber disc with tissue paper, and a little vaseline once in a while, the lighter is kept in perfect working order. There is practically nothing to wear out. The writer has had one in use every night for a month lighting seven or eight jets, and it has worked most satisfactorily, consoling one greatly for the absence of available electric light in the locality.

A Novel Main Switch.

In breaking the circuit in conductors carrying heavy currents and of high E. M. F., considerable flashing is apt to take place, which burns the copper and impairs the contacts, so that finally the latter have to be replaced. To avoid this difficulty, Mr. Wm. Hochhausen, of the Excelsior Electric Company, has constructed a switch in which the flashing is expended upon a carbon rod so that no injury is done to the main contacts. The apparatus, which is shown in the accompanying illustration, Fig. 1, consists of the ordinary pivoted bar and handle, and makes contact between two springs. Pivoted loosely on the same spindle is a second curved arm which carries a carbon rod, bearing upon a similar rod below it, the latter being connected to the other side of the circuit. Now, when the switch is closed, the current has two passages open to it; one through the regular connecting bar, and the other through the carbon rods, which are pressed into contact by a spring.

Now, when the switch is raised to break the circuit, the copper connecting bar breaks contact first, but the carbon rods still maintain contact by the pressure of the spring. The entire current then passes through the carbon rods, and, on raising the handle full up, the contact between them is ruptured, breaking the circuit completely. The flashing, therefore, can only take place between the two carbons, so that the real contacts are completely protected. It is evident that when the two carbons are worn, they can be readily and cheaply replaced.

Mr. Hochhausen has recently designed a snap switch intended to be placed in connection with incandescent lamps on arc circuits. The arrangement is shown complete in Fig. 2, and the switch, with cover removed, in Fig. 3. The electro-magnet within is of high resistance, and placed as a shunt around the terminals of the lamp. It is so wound that when the E. M. F. at the terminals of the lamp slightly exceeds the proper limit, the armature opposite the magnet is attracted. This releases the snap switch, which cuts out the lamp and continues the circuit around it.

The switch is set by means of the bent lever extending through the cover. An attachment is provided, so that whenever it is desired to extinguish the lamp it

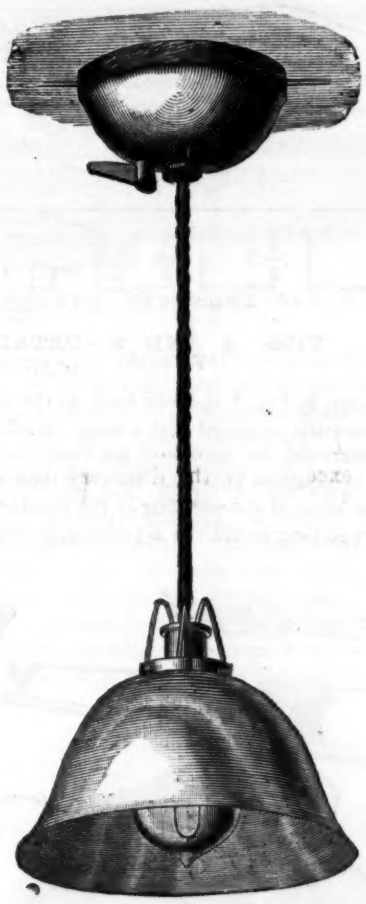


FIG. 2.—INCANDESCENT LAMP CUT-OUT.

can be done. This is accomplished by pressing from below the knob shown in Fig. 3. The latter has a spindle attached to it, conical at a certain point; thus, when pressed upward, the cone-shaped portion presses against the armature and releases the switch in the same way as if the armature had been attracted by the magnet.

Filing Electrical Patents for Reference.

BY S. S. WHEELER.

Nearly every one who is engaged in an electrical manufacturing business has occasion to keep himself posted upon the patents affecting his line of work. This he proceeds to do by getting copies of patents and studying them, and, if his business is a large one and requires system, making his own notes and comments upon the patents in the respects in which they interest him. In order to facilitate the finding in his file of a patent which he wants at a particular time, the first thing he does is to have the subject, date, number and inventor of the patent indorsed on the outside, so as to be able to tell at a glance which one it is, without opening the patent. It is safe to assume that one-half of the copies of patents which are sent out from the patent office are thus indorsed in various kinds of hand-writing, giving rise in different files and libraries to great irregularity of method and classification and various degrees of illegibility. Would it not be an excellent thing to prevail upon the patent office to print these few lines on the outside of patents while they have the type set up with which they print the information on the top of each sheet of drawings?

This will cost less than a quarter of a cent per patent, for which, if necessary, the public would be glad to pay an increased price. It would secure great legibility and would save the individual collector all of the annoyance and trouble in getting single copies correctly indorsed on the outside. Again, the result of its not being worth while for the individual collector to put much thought upon how it is best for him to arrange his patents, is that he has them indorsed in the most natural place, namely, the right hand upper corner. Then in running over a file so that his fingers will pass over that corner of all the patents where he has indorsed the name on each patent, he cannot be sure to raise just one patent with each motion of his finger, because the pages are loose and he will get one leaf at a time. If the information desired is on the left hand corner where the leaves of a single copy are all gummed together, the user will be sure to get just one patent at a time when running over the file with his fingers and will readily see the indorsement on each patent, and will see no leaves except the indorsed outside of each patent. Would it not be well for the electrical societies to draw the attention of the Patent Office to the convenience of this arrangement and the great regularity which it would secure, at an inappreciable expense?

It would also be a great improvement to have the edges

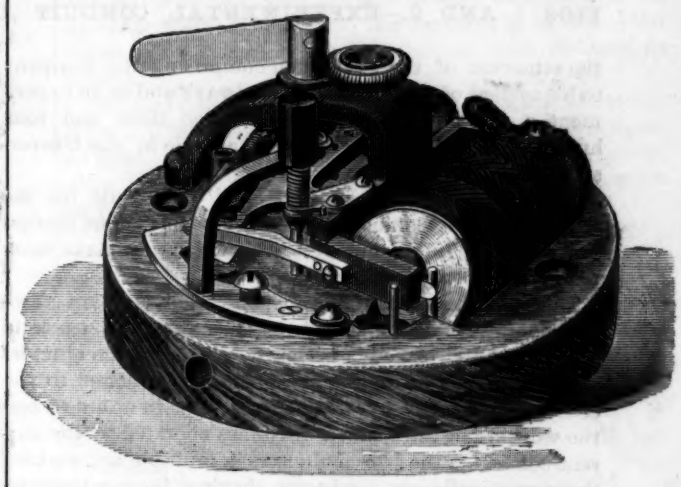
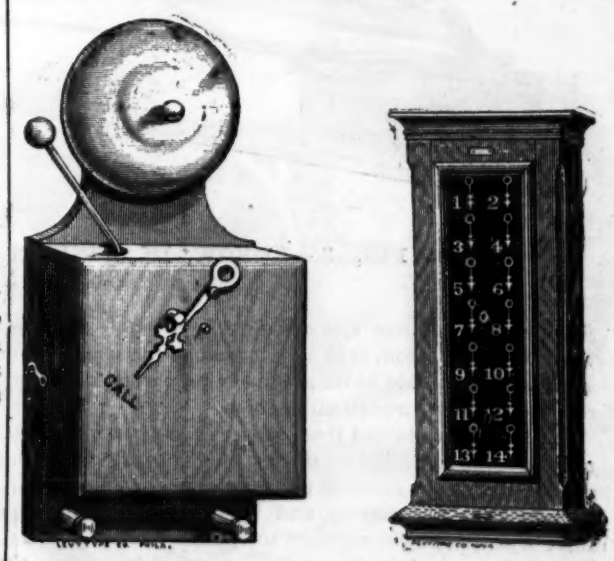


FIG. 3.—INTERIOR OF CUT-OUT.

of patents trimmed to a uniform size, as it would prevent the edges from being torn.

A New Indicating Box Bell and Annunciator.

It frequently happens that where a call bell is used to summon an attendant, the latter is absent, and upon his return no indication is given that the bell has been sounded. To obviate this difficulty Messrs. Partrick & Carter, of Philadelphia, have devised an attachment to the call bell, shown in Fig. 1, which throws a needle over to indicate that the bell has sounded, so that the attendant on his return will become aware of the fact that a call has been sent. The needle must be reset by hand, so that after each call it is ready for a new indication. Even if the bell



NEW INDICATOR BOX BELL AND ANNUNCIATOR.

should fail to ring on account of a disarrangement, the needle would indicate the call, so that a double indication is given.

The firm also manufactures the needle annunciator for cars and steamships, and shown in the illustration, Fig. 2. The instrument has a lock attachment, so that it is impossible to get false indications by the jarring of cars in turning sharp curves, etc., or in steamships or where vessels are liable to rock. With this lock attachment the annunciator can turn a complete circle without the needles showing any indication, and when circuit is made the needle flies into position and remains there until thrown down by a mechanical appliance moved by hand.

New York Subway Secrets.—Mr. McMahon, the promoter, is now giving evidence in his suit against Mr. Flynn for the interest promised him in the subway deal. He mentions a number of well-known men as connected with the various moves and schemes. He says that one person tried to buy out the Consolidated Company with the help of some Western Union directors, but that the negotiations ceased when $1,000,000 was asked.

The Short-Nesmith Electric Railway System.

In the month of February, 1885, a company was organized in Denver, Col., under the name of the Denver Electric and Cable Railway Co., for the purpose of building and operating an electric railway in the streets of Denver. It adopted a plan proposed by Mr. Sidney H. Short, then Professor of Physics in the University of Denver, who called the attention of the gentlemen comprising the company to his system of series electrical railway; and as an experiment a short piece of track, between three and four hundred feet in length, was laid in a circle in the University grounds.

A small car named "Joseph Henry" was built for the track and carried many hundreds of people. The success of this little road encouraged the company to make more extended experiments in this direction.

This first road was built on the following plan: Two bare conductors were laid side by side along the track in a small conduit placed between the rails. The conductors were small and supported on insulators attached to the cross ties, and they were cut into sections in order to test the working of the system. Switches operated by the current connected the two conductors in multiple arc, making them practically one conductor, having the conductivity and sectional area of the two. These electrical switches at the same time connected the ends of the sections of this double conductor, making one continuous conductor along the entire length of the track. The ends of this working conductor were connected by means of wire with the dynamo. When a car was placed on the track and had its brushes or contact springs, one on each of the parallel conductors of any section, the electrical switches at each end of that section would at once disconnect one of these conductors at one end and the other at the other end, leaving the only path for the current along one conductor, through the motor to the other conductor and to the line again. These sections could be made any convenient length, from that of an ordinary car to a block or a mile. A car could be on every section and the same current would pass through all of them.

Mr. Short maintained that greater economy in electrical railways was to be had by the use of a constant current of small quantity, by running the cars in series like arc lamps or telegraph instruments, and varying the electromotive force with the power required to operate the line of road. This main principle has not been varied from since the beginnning, but many modifications of the details of construction have been made from time to time.

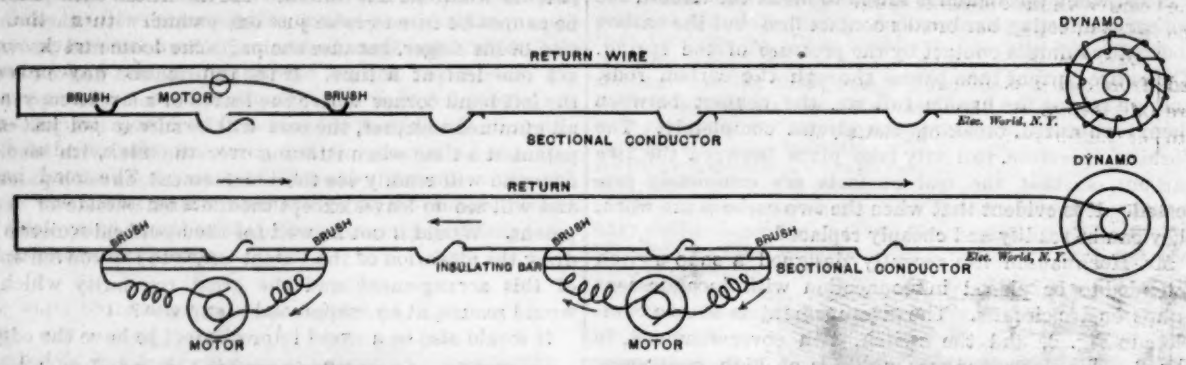
The two conductors used in the first arrangement were intended to carry the current in the same direction at the same time along the track, and, as stated above, they became electrically one conductor.

At the junction of the two sections there were four contacts to be operated by an electrical circuit-closer, which was necessarily a complex and delicate piece of mechanism to keep in good working order, especially when placed on the street where it was liable to injury.

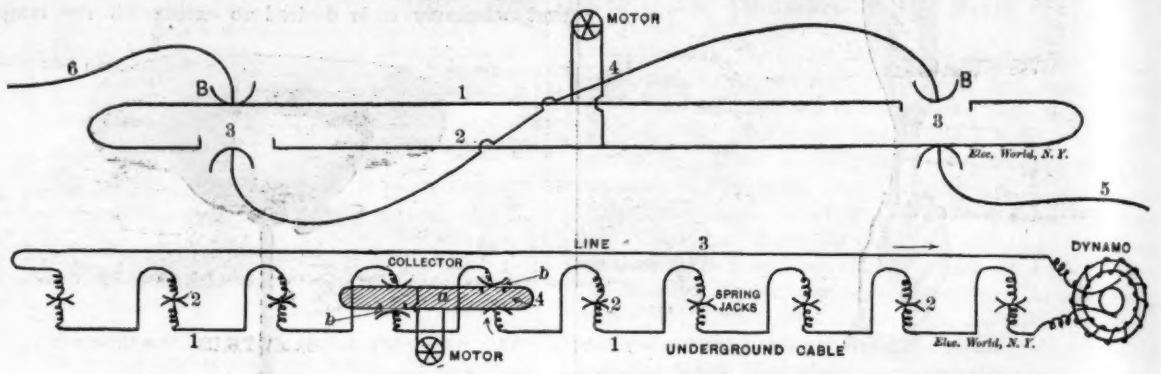
Mr. Short therefore set about to devise some means of combining the two wires in order to do away with one pair of contacts at the junction of the sections, and thus to lessen by one-half the chance for leakage from the insulating supports. He found only one thing to do, *i. e.*, to shorten the sections of the conductor to the length of one car or train of cars. This increased the number of circuit closers greatly, but at the same it increased the flexibility of the road, as cars could be run as close together as they could be placed upon the track.

On this plan a contact brush must be placed under each end of the car or train of cars to make electrical connection with the conductor so that there will always be a circuit-closer between these brushes, as shown in Fig. 1. The circuit-closer between these two brushes must, however, be kept open as long as it remains between these brushes, and must close the line as soon as it passes from between them.

Electrical means for accomplishing this were devised, but were open to the same objection as the one referred to above, and with the large increase in number this objection became still greater. It thus became evident that a mechanical circuit-breaker must be used. Mr. Short presented this plan to Mr. John W. Nesmith, a practical mechanic of long experience, and asked him to devise some mechanical means for keeping the spring or circuit-closer, shown in Fig. 1, open as long as the car was over it. Mr. Nesmith proposed that a long, slender bar of insulating material be stretched between the two current-collectors or brushes, this bar to slide between the contacts at the ends of the sections of the conductor and keep them apart so long as the car is passing, as shown in Fig. 2.



FIGS. 1 AND 2.—EXPERIMENTAL CONDUIT CONNECTIONS, DENVER ELECTRIC RAILWAY.



FIGS. 4 AND 5.—DETAILS OF ARROW AND CONDUIT CONNECTION.

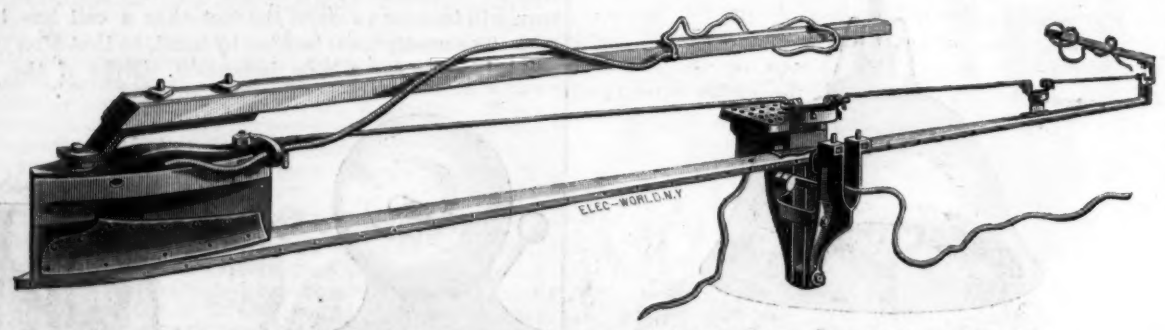


FIG. 3.—ARROW IN CONDUIT, DENVER ELECTRIC RAILWAY.

In July, 1885, this second plan was tried on about three hundred feet of track with the same car used in the first experiment. A brush at each end of the car made contact with two sections of the conductor and a leather strap stretched between the two brushes kept the springs apart as the car passed over the circuit-closer. This experiment was a highly successful one, and the desired end was attained.

The Denver Electric and Cable Railway Company in consequence ordered the material to lay one-half mile of track upon this plan, and also two motors and one dynamo of the Short type. A small engine made by the Colorado Iron Works, of which Mr. Nesmith is proprietor, was put in place near one end of the line. This engine was of the ordinary slide-valve form with a cylinder 9 inches by 12 inches. Two beautiful coaches were built by Woeber Brothers in Denver.

The electric conductor used in this trial was a slotted copper tube of about one inch inside diameter. Each tube was about 16 feet long and imbedded in asphaltum and tar. The whole was encased in an iron shell and a slot was cut through at the top. These centre rails were spiked to the ties. Between the ends of these sectional conductors were mechanical contact closers. The car was provided with a contact brush at each end, which fitted into the tubular conductor like a gun-wiper brush. Between these brushes was stretched a long, flexible rubber cylinder which almost filled the tube. As the car moved along the forward brush was pushed through the tube and contacts at the ends, the rubber rod followed and kept the contacts apart until the rear brush had passed and the current was forced to pass from one brush through the motor and back to the other brush.

In October, 1885, this half mile of track was completed and for the first time a car driven by electricity made its appearance in Fifteenth street, in Denver. The experience of a few days showed this plan to be impracticable on account of the difficulty of keeping the conductor insulated. A very little sand and dust in the tube would stop the brushes. The most serious difficulty to overcome, however, was the leakage due to imperfect insulation.

To overcome this difficulty, an ordinary underground cable was substituted for the bare conductor. This, by Mr. Nesmith's suggestion, was laid in the ground outside of the conduit, leaving the conduit for the passage of the current-collecting brushes, and mechanical circuit-closing springs were placed at intervals in the conduit, as before. By this arrangement it was necessary to provide carefulinsulation only for the exposed ends of the sections of the conductor. This was a great stride towards success with the conduit system, but the change in the arrangement of conductors made a new device for connecting the current-collectors necessary. This was accomplished by the construction of a collecting bar shown in perspective in Fig. 3, as it appears when between a circuit-closer on the line. Fig. 4 shows the arrangement of the bar diagrammatically, and Fig. 5 is a diagram of the circuit connections. As will be seen from Fig. 4, three adjoining sections of the underground cable are connected with the two circuit-closers *B B*. But when the current-collector is removed from the circuit-closers *B B*, these closers are in contact, and the line is continuous as shown in Fig. 5.

The current-collector is made of a slender bar of insulating material, somewhat longer than the section of the conductor between circuit-closers. The metal strips, 1 and 2, are fastened around the entire edge of the bar, except at 3 3, where there are short insulated breaks, as shown. Wires pass from these metal strips, 1 and 2, to the motor. The current passes from section 5 to metal strip 2, through the motor to metal strip 1, and thence to section 6. The middle section of the conductor 4 is cut out of circuit when the current-collector is in the position shown in the figure. If the bar be moved in either direction it will be seen that no flashing can occur, nor can the line be short-circuited. This current-collector is 2½ by 1½ inches in section, and about the length of a car. It is supported in the conduit by attachments passing down through the slot.

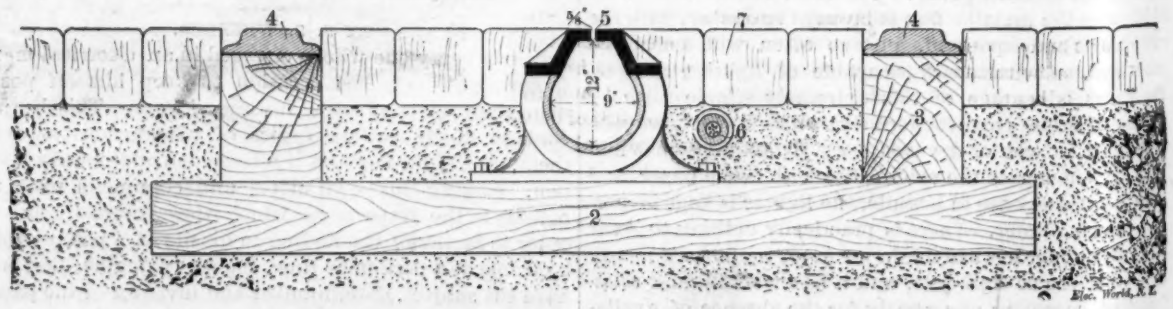


FIG. 7.—CROSS SECTION OF CONDUIT AND TRACK.

In November, 1885, the company put down on the same street 500 feet of the new line of insulated wire for one of these current-collectors, and it worked to perfect satisfaction. During the winter of 1885 and 1886 this short line was worked in all kinds of weather, in snow, rain and mud. The tracks were flooded and the severest possible tests were made to prove its merits and it never failed.

Upon this a new company, the United States Electric Company, comprising many of the members of the local company, was organized in August, 1885, for the purpose of developing the system.

The officers of the company are: Wm. N. Byers, Presi-

dent; S. H. Short, Electrician; J. W. Nesmith, Mechanician, and E. Grace, Secretary. In June and July of 1883 the new company put down under contract 3,100 feet of an electrical railway upon the last plan, for the Denver Electric and Cable Railway Company. This track was laid on Fifteenth street, between the Court House and the Post Office. Ordinary cross ties were used, upon which were strung 20 lb. T-rails. Notches were cut in the centre of the ties to form the conduit, and planks were spiked to the ties so as to cover the notches and to make the slot. The edges of the slot were protected by strap iron.

Under one of the planks was laid a Waring lead-incased cable of No. 3 B. & S. gauge. Circuit-closers were placed every 25 feet and the cable cut and attached to the track to dig a trench down to the cross-ties and to put down the cast-iron conduit, which is made complete in sections of 8 feet. Before the pavement is relaid, the lead incased cable is laid along at one side, as shown, all insulated and complete. The change from horses to electricity can be made in this way, without interfering with the regular running of the road.

The current which feeds the motor is used to light the cars with incandescent lamps, and to operate an alarm gong to warn persons of the approach of the cars. The latter can be moved backward and forward and governed from either platform. A few days since, according to Mr. Sidney H. Short, to whom we are indebted for many of the foregoing details, indicator cards were taken from

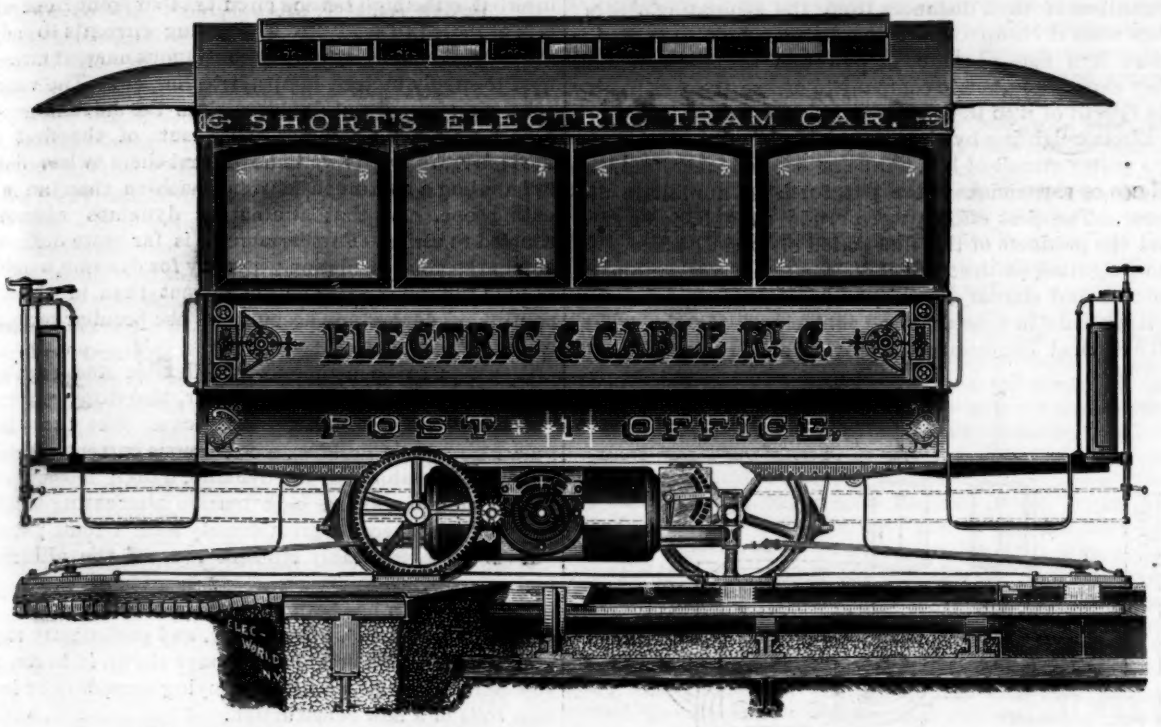


FIG. 6.—CAR, MOTOR AND CONDUIT, DENVER ELECTRIC RAILWAY.

them. The two coaches built in Denver were placed upon the track. Each car had a motor of the Short type, made in Denver, and was supplied with both reversing gear and speed gear. Each motor weighed about 1,500 lbs. Tests were made of the efficiency of these motors when they were developing from 5 to 8 horse-power, with a current of 25 ampères, and they showed a return of 80 per cent. Our illustration, Fig. 6, shows a longitudinal elevation of one of the first two cars on a section of the new road-bed and conduit.

On these cars these motors were placed on frames which were hung from the axles of the car trucks, and carefully insulated from them. On the armature shaft of each motor was placed a raw-hide pinion. This pinion drove an iron gear on a counter-shaft which had its bearings attached to the same frame. The counter-shaft carried another pinion which meshed with the large gear of the driving axle of the car. This method of gearing was direct and positive, made little noise, and admitted of a simple and efficient reduction of speed from the motor armature shaft to that of the car axle.

The small engine and dynamo first placed in the plant were used to furnish the power.

On the 31st of July this road was started and the car moved from one end of the track to the other without a mishap. This road was run constantly for three months, two men being required to operate it, one at the engine and one on the car.

In the meantime the Denver Electric and Cable Railway Company consolidated with another local company, and the new association took the name of the Denver Tramway Company. This company contracted with the Denver Tramway Construction Company for the equipment of its lines with the improved system. The work was immediately begun and 3½ miles are now fully equipped and in operation with seven cars running. A new conduit of cast iron is used on this line and is shown in longitudinal perspective in Fig. 6 and in transverse section in Fig. 7. The slot is ⅝-inch wide and the conduit is enlarged to 9 × 12 inches, and is of substantial construction. The new truck and gearing with Brush motor is shown in Fig. 8. It will be seen that the ordinary street car wheels and axles are provided with an iron frame supported upon spring pedestals upon which the motor is fastened. On the shaft of the motor is a pinion which drives a gear wheel on a short counter-shaft; the latter again carries another pinion which meshes with a large toothed gear wheel keyed to the axle of the car wheels. The greatest ratio between the pinion and the gear is 1 to 5, and hence very little noise is made. The car body and truck are each complete in themselves and are put together simply, so that cars that are now being pulled by horses can, without much expense, be adapted to the electrical system.

The conduit shown in Figs. 6 and 7 is so arranged as to admit of its being put down on existing horse-car lines. It is necessary to remove the pavement only in the centre of the engine while three cars were in service. These showed an average of 32 h. p. delivered to the driving belt. A constant current of 40 ampères was passing over five miles of No. 3 B. & S. gauge conductor. The resistance of the circuit is 7 ohms; hence the circuit alone used 15 h. p., which left 17 h. p. for three cars, the friction of belting, shafting, dynamo, etc. This gives an average of 5.66 h. p. for each car. One of the three cars, it may be added, was climbing a grade of 350 feet to the mile at the time of the tests. and it is safe to assume that it was using one half of the power delivered to the cars. Hence each car can be run at the expense of 5 h. p. delivered at the engine after the power necessary to overcome the line resistance has been deducted. It is estimated that a good Corliss engine will deliver 5 h. p. for one hour with the consumption of 15 lbs. of coal, or for 20 hours 300 lbs. will be required. Thus at $3 per ton the cost for fuel per car will be 45 cents per day. A constant expenditure of 15 h. p. will be required to send the current over the line. As this amount will not vary with the number of cars on the line, the cost for fuel for constant current on the entire line will be $1.50 per day. The conductor used in Denver, however, is too small. It was used first for 30 ampères and was not changed when 40 ampères was adopted; hence the loss from this cause is abnormally large.

Large buildings have been erected and a Lane & Bodley 16 by 42 Corliss engine put in place. A 100 h. p. Brush dynamo, and a 100 h. p. Short automatic dynamo for constant current constitute the motive power plant, and five Brush motors have been placed under as many new cars. On the last of November the new machinery was started.

The road now in operation comprises some very difficult problems in electrical railroading. Starting in the east end of Denver, on top of Capitol Hill, a single track passes down a grade of 350 feet to the mile. At the bottom of the hill it crosses two horse car tracks and then curves into Fifteenth street. When it reaches the Court House it divides into a double track with automatic slot and track switches, which turn the down car into the right-hand track. The double track continues for three-quarters of a mile, and on its way crosses five horse car tracks, two on curves. It then returns to a single track which crosses five steam railway tracks, enters a turnout, crosses another horse car track, and as a double track crosses a bridge 200 feet long. The road has been running through the severest winter weather. A heavy snow fell soon after it was started. and snow-plows put on the cars cleaned the track perfectly during the regular trips.

Each car is provided with sand boxes and pipes and the track can be sanded by the driver from either platform. The driver has a simple movable handle, which fits on an upright shaft in front of the dashboards of the platforms. With this he speeds the car and reverses its motion.

The cars pass a given point, going in the same direction, every ten minutes, making an average speed of six miles an hour. However, cars have been run over the line at night when the streets were clear, at the rate of 25 miles an hour.

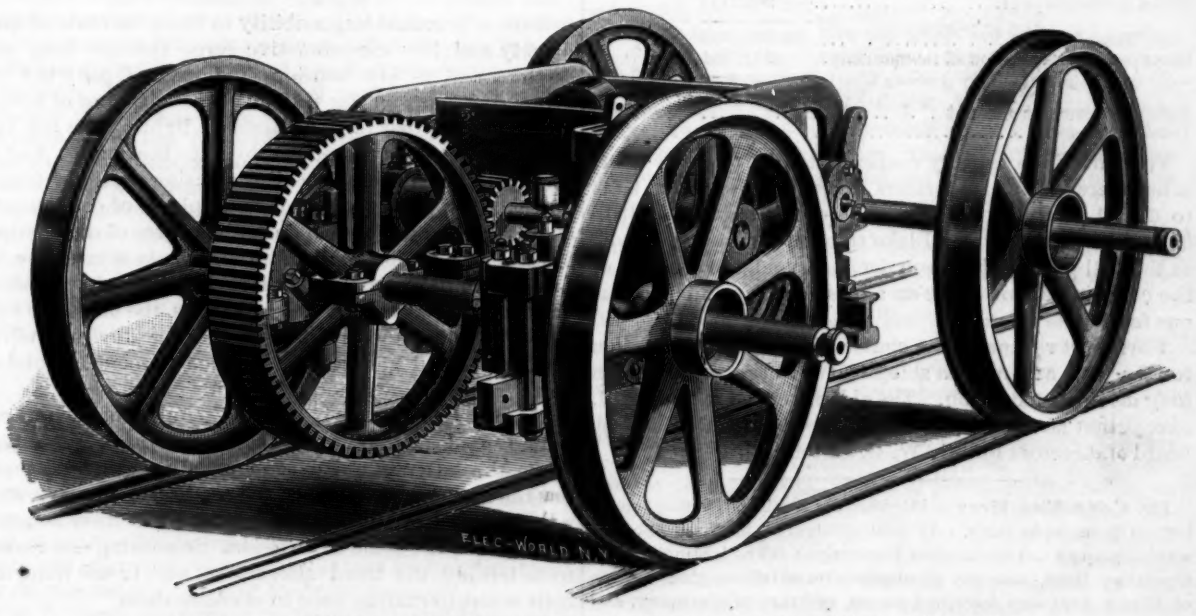


FIG. 8.—MOTOR AND TRUCK, DENVER ELECTRIC RAILWAY.

Reorganization of the Schuyler Company.

At the meeting of incorporators of the Schuyler Electric Manufacturing Company, held on Thursday, March 24, a board of directors consisting of C. L. Buckingham, of the Western Union Telegraph Company, New York; John Byrne, of the Chesapeake & Ohio Railroad, New York; H. M. Pierson, of Brooklyn, N. Y.; S. E. Elmore, president Connecticut River Banking Co., of Hartford; C. N. Wayland, treasurer of the Holmes, Booth & Haydens Co., of Waterbury, Frederick Fosdick, treasurer of the Fitchburg Steam Engine Co. and Mayor of Fitchburg, Mass.; and Chas. E. Dustin, of Hartford, were chosen for the ensuing year. Mr. E. Henry Hyde, Jr., of Hartford, was also chosen by the stockholders as treasurer of the Company, it, however, being understood that this was to be temporary to enable a certain other prominent gentleman to perfect his arrangements for accepting the office. The stockholders expressed themselves as well pleased with the progress of the business and with the hard work done by Mr. Dustin and the Advisory Committee appointed by the creditors since the time of the Bartholomew troubles. The Hon. Frederick Fosdick, as one of the Advisory Committee, spoke at length regarding the condition of affairs, and expressed himself as fully satisfied that the future of the company would be great, and that the stockholders of the old company, who were now by agreement and by the act of the Legislature, incorporators of the new corporation would receive the full amount of their stock, as the company had made most important progress in electrical apparatus, and more orders were coming to it than it could possibly take care of at this time. The company manufactures everything pertaining to the work in its own factory and under its own patents, paying royalty to no one. At a meeting of the directors held after the stockholders meeting Mr. Chas. E. Dustin was unanimously chosen president; Mr. C. H. Sewall, of New York, secretary.

Mud and Water Currents.—Mr. A. C. Tichenor has been making a sensation in San Francisco by claiming to produce very large currents from mud and water, using a special kind of mud. When put to the test, the mud was found inadequate, and the invention is looked upon as a fizzle if there was really anything in it at all, which seems open to do ubt.

Annual Meeting of the American Bell Telephone Company.

The annual meeting of the American Bell Telephone Company was held at Boston on March 29. President W. H. Forbes in the chair. The report said :

"Our business for the year ending Dec. 31, 1886, was marked by an improvement over the previous year, especially in exchange subscribers—the total number showing an increase of 9,318, as against 2,969 in 1885.

The following comparative statistics will be found of interest :

EXCHANGES.

	1886.	1887.	Increase.
Exchanges	747	736	11*
Branch offices	428	446	18
Miles wire on poles	100,332	111,349	11,017
Miles wire on buildings	10,043	10,587	544
Miles wire underground	3,417	6,030	2,613
Miles wire submarine	254	265	11
Total miles wire	114,046	128,231	14,185
Total circuits	112,067	121,260	9,193
Total employés	5,433	5,843	405
Total subscribers	137,750	147,068	9,318

* Decrease.

EXTRA-TERRITORIAL LINES.

	1886.	1887.	Increase.
Number of lines	897	911	14
Miles of pole lines	30,697	31,143	446
Miles of wire	41,745	43,767	2,022

UNDERGROUND WIRES IN PRINCIPAL CITIES.

	1886. Miles.	1887. Miles.	Increase.
Boston	289	347	58
Brooklyn	134	1,233	1,099
Chicago	760	1,462	702
New York	627	627	....
Pittsburgh	614	966	352
Washington	992	1,302	310
Total	3,417	6,030	2,613

INSTRUMENTS.

	1884.	1885.	1886.	Increase.
In hands of licensees	325,574	330,040	353,518	23,478

The estimated average number of exchange connections daily in the United States is 856,454, or a total per year of 312,605,710. The number of daily calls per subscriber varies in different exchanges from 2 to 15, the average throughout the United States being 5 82-100, as compared with 5 43-100, the number reported last year, an increase of 7 per cent.

The average cost to the subscriber varies, according to the size of the exchange, and character of the service, from 2 to 7 cents per connection.

The average daily number of extra-territorial connections is 7,402, or a total per year of 2,701,730. The extra-territorial earnings for the year amounted to $565,514, of which this company's share is $75,617, an increase over 1885 of $2,208.

The Treasurer's statement shows :

Gross earnings from all sources		$3,097,000
Expenses		1,149,717
Net earnings		$1,947,283
Miscellaneous credits		26,067
Total		$1,973,350
Regular dividends paid	$1,176,252	
Extra dividends paid	392,084	
Total	$1,568,336	
Reserve for depreciation of instruments	117,754	
		1,680,090
Balance to surplus account		$287,260
Total surplus		1,491,380

The Canadian company continues to do extremely well ; it has increased its subscribers during the year from 9,614 to 11,600, and its net earnings from $158,000 to $190,565.83; and although the Blake transmitter patent, as well as the Bell patents, has been declared void, the business of the company seems to be on a most healthy and prosperous footing.

The report rehearsed the course of telephonic litigation for the year, and made a statement as to the work done in long distance extension. The old officers were re-elected, except that Mr. John E. Hudson was substituted on the board of directors for Mr. W. G. Saltonstall.

Dr. Cornelius Herz is introducing a micro-telephone push button to notice in Paris. It was illustrated in these columns some time ago. The London *Times* says : "The inventor is Dr. Cornelius Herz, one day nominated Grand Officer of the Legion of Honor, next day described as an emissary of Germany, and lastly as the friend, adviser and confidant of Gen. Boulanger. He is in reality an electrician whose inventive talent has been stimulated by his residence in America, where there is a boundless demand for improvements in electrical apparatus and in all mechanical contrivances."

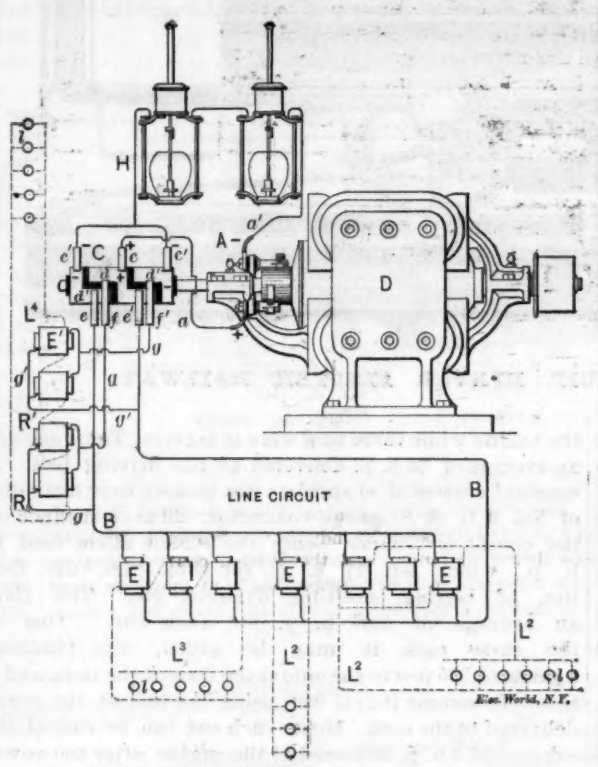
Prof. A. G. Bell.—Speaking of Prof. Bell's lecture at the University, the college paper, the Cornell *Crank*, says : "The lecture was illustrated throughout by a large number of admirable drawings thrown on the screen by the large lantern of the physical lecture room. Some of the views of early apparatus were not only interesting, but valuable for their historical value. The speaker, throughout, carried his audience with him, as his manner was easy, and withal intensely interesting. As he described the steps leading up to the invention of the photophone, he held the attention of his hearers transfixed with the same expectancy that the good reader awaits the *denouement* of the plot. On arriving at the lecture room, he may well have expressed surprise, by his introduction. 'I scarcely thought in getting in that I should be able to hear my own lecture,' for never before, indeed, has such a dense mass of humanity collected in that hall. His audience were agreeably surprised to find him a man of so modest mien, when he has the distinction of having such exalted honors."

Long Distance Distribution of Electric Energy.

BY A. PFANNKUCHE.

Even the casual observer cannot close his eyes to the fact that the science of electricity, and the practical application of the same for lighting, locomotion, distribution and transmission of power purposes, is progressing with marvelously rapid strides. It is not many years ago when electric light systems were considered almost complete if they would run 30 to 50 arc lamps in series satisfactorily, or supply currents for glow lamps over a district of about half a mile radius. But as the numbers and classes of consumers increased, so also did their demands. To-day they want electric current for glow lamps, for arc lamps, for motors, for electrolytic purposes ; they want it regardless of their distances from the generating centre ; they want it cheap to meet increasing competition, and if there is a natural source of power in the neighborhood, they expect an electric company to utilize it so as to give the benefit of it to their customers.

Electric lighting by glow lamps would not be tied down to a paltry circuit of half a mile or so, and, therefore, the efforts of electricians were put forth to annihilate distance. The first efforts were crude enough, to be sure, and the products of this first period of long distance glow lamp lighting (with so-called distribution boxes, automatic cutouts and similar devices) will soon be assigned a last resting place in museums and junk shops. It was clear to all electrical engineers that it was, and probably would



PFANNKUCHE SYSTEM OF DISTRIBUTION.

remain, a practical impossibility to force currents of great density and low electromotive force through long conductors, and as low tension and great density is a condition *sine qua non* for the successful lighting of houses, it was evident that for long distance lighting the low electromotive force dynamo had to go to the wall. And yet there remained the necessity of using such low tension currents inside the houses or other places of consumption at a considerable distance from the centre of distribution. These considerations pointed naturally to a compromise, to a combination of high tension current in the street mains, and low tension in the houses, the one to be commuted into the other by some translating device, such as, first, motor and generator combined ; second, secondary batteries ; and third, induction coils pure and simple.

The first two alternatives would require continuous current dynamos, which must count as a great advantage, while the latter would depend on alternating currents ; but the first device would be too costly and clumsy, while secondary batteries are still doubtful as to their length of life, and require some supervision. So nothing else seemed to be left but the third alternative, and to use induction coils with alternating coils to energize them.

This latter combination forms the basis of two systems of long distance lighting which have been tried in Europe, viz.: the Gaulard & Gibbs system and the Zipernowsky-Déri system. Both have been described in this ever wide awake paper.

In both of these systems alternating dynamos and alternating currents are used from the beginning to the end, with the result that all electrical apparatus requiring continuous currents, as, for instance, motors, secondary batteries, electro-plating apparatus, and almost all the different types of arc lamps in use in America, are debarred from utilizing the current furnished by these systems.

This is a very serious defect, and demonstrates the incompleteness of both systems, especially where, as in America, such rapid progress is being made with the introduction of motors into factories and private houses. That those systems, and especially the Zipernowsky-Déri system, have been able to do good work in Europe in spite of the great defects mentioned above, proves the great demand there is for this kind of work, rather than the perfection of the systems themselves, while it absolutely proves, that here in America, where the quick perception and intelligence of the people has brought about a far greater use of electricity and its applications than anywhere else in the world, a complete system, such as sketched out above, but without the grave defects shown therein, must also be a complete success.

Such a system would supply current to arc lamps, glow lamps, motors, secondary batteries, as well as electrolytic apparatus ; in fact, it would lend itself to every possible application of electricity.

To achieve this desideratum, the alternating dynamo must give way to the continuous current machine, and a simple, effective and sparkless current alternator must be inserted in the high tension circuit at that point from which it is proposed to send out alternating currents to supply the induction coils, while the continuous current circuit is used to supply motors, lamps, batteries, etc. The very use of continuous current dynamos gives the advantage of a higher efficiency of at least 20 per cent. of the first over the latter, while it is well known that there is less danger in handling a continuous current machine than an alternating one, and that alternating dynamos cannot be coupled in series. Furthermore, it is far more difficult to obtain the good insulation necessary for dynamo machines of high tension for alternating current than in those for continuous current, on account of the peculiar properties of the former.

A system to be complete and flexible and capable of serving all legitimate purposes must, therefore, embrace a continuous current high tension dynamo (like those in use on arc circuits at present), a continuous current circuit, a current alternator near the dynamo, a high tension alternating main circuit, a high tension alternating local circuit and a low tension great density local circuit ; the last but one to be preferably multiple arcs off the alternating main circuit.

Such a system has been devised by the writer, in conjunction with Mr. G. Pfannkuche, and preliminary experiments with such a combination have shown it to be very successful, especially when employing secondary or induction coils of a new construction.

The current alternator—there is only one for each plant used by the writer—is the result of many trials, and is of very simple and cheap design. It rapidly changes the direction of the continuous current without a possibility of sparking even with the heaviest currents, and without the slightest chance of ever breaking the main circuit, thereby insuring the absence of disturbances in that part of the circuit where steady continuous currents are required, and without any loss of energy whatever while supplying the induction coils with alternating currents of predetermined periodicity. The number of alternations can be regulated at will without interfering with the work or speed of the dynamo, so that if it should be desirable, the alternating circuit could even be regulated by automatically changing the rate of alternations to suit the desired output of the induction coils or converters.

The means of regulation are numerous. A compound-wound dynamo, without any mechanical regulating apparatus for keeping the difference of potential at the terminals of the induction coils uniform, and thereby permitting of the putting on and off of any number of lamps without reaction on the remaining lamps, and without waste of power for lamps not in use, has proved very successful. The writer has, however, found by experience that the most economical and most reliable regulation is effected by attaching an electrically-impelled governor to the prime mover itself, which regulates the consumption of steam or water-power in proportion to the work performed by, and drawn from, the dynamos.

The general idea of the Pfannkuche system of long distance distribution is shown in the accompanying illustration. From the brushes of the dynamo lead the wires $a\ a'$ of the circuit A. One of these wires a terminates at a brush c, and the other a' is branched and leads to two brushes $c\ c'$.

The alternating commutator C consists of three segments, d and $d'\ d'$ mounted on the prolonged armature-spindle of the dynamo, and insulated therefrom and from each other. The middle segment d is made cylindrical at its centre, and has semi-cylindrical arms projecting therefrom in axially opposite directions and on diametrically opposite sides, and the outer segments, $d'\ d'$ are made cylindrical at their ends, and each has a semi-cylindrical arm projecting axially and overlapping one of the like arms of the middle segment. The wire a brings positive currents to the brush c and segment d, while the wire a' brings negative currents to the brushes $c'\ c'$ and segments $d'\ d'$. Two take-off brushes $e\ e'$, termed the "primary" brushes, are joined to the opposite terminals of circuit B, and rest against the commutator C in such position that each shall contact alternately with the positive segment d and one of the negative segments d', and so that while one is in contact with the positive segment the other shall be in contact with the negative segment ; hence when the commutator revolves, the line-circuit B receives alternate positive and negative impulses, one to each revolution. In addition to the primary brushes $e\ e'$ there are also two secondary brushes $f\ f'$, which have a slight lead relatively to the primary brushes, and which are connected through

branch wires g g' to the respective wires of the line-circuit B.

If only the brushes e e' were employed to take off the current from the alternating commutator, the circuit would be broken whenever either of these brushes passed over the insulation between the commutator sections—that is to say, twice to each revolution. This would occasion violent sparking at the commutator and heating of the armature-coils, which would be ruinous to the dynamo and the commutator. This is prevented by using both primary and secondary brushes, and setting one as much in advance of the other as the width of the insulation, so that at the instant of crossing the insulation the leading brush makes contact with the positive segment before the other breaks contact with the negative segment, so that the circuit of the dynamo is never broken; but this arrangement alone would cause a short-circuiting of the line at each crossing of an insulation, by the positive current flowing, for instance, into brush e, and thence back through brush f to the negative segment without traversing the line B. Thus the entire resistance of the line would be cut out for an instant twice at each revolution, thus heating and injuring the dynamo, The resistance R prevents this result, not by preventing the short-circuiting from brush e to f and e' to f', but by making this short circuit of equal resistance to the line, so that the dynamo feels no difference whether the current traverses the line or the short circuit. In this manner the circuit to the dynamo is in effect neither broken nor short-circuited, and no sparking or heating is caused. It is apparent that during the instant while the brushes e f are on opposite sides of the insulation there will be no current supplied to the line-circuit B, but upon both brushes reaching the same segment of the commutator C, the current to the line will be established in a direction reversed relatively to the preceding current. The rapidity of the alternation of the currents in the line-circuit will depend upon the speed with which the alternating commutator is revolved. If it be fixed on the armature shaft, as shown in the illustration, it will revolve at the same speed as the armature.

It is evident, however, that the commutator may be mounted on a separate shaft and driven independently at any speed.

The secondary coils of the converters E E may be joined in the local circuits in any desired way, according to the work which the several local circuits are expected to perform. In Fig. 1 are shown three different methods—the circuit L', including but one converter, the circuit L^2, including three converters installed in multiple arc, and the circuit L^3, including three converters installed in series. In either case the incandescent lamps l l may be joined in multiple arc, or in any other arrangement.

As stated above, the writer prefers to render the machine self regulating by using compound winding.

In the use of rheostats R R' more or less energy expended in overcoming the resistance is wasted by being converted into heat. To economize this waste, there may be substituted for the rheostats one, two or more converters E' E', identical wih those in the main line, except that the resistance of their primary coils may require to be somewhat different. In the illustration there are shown two converters E', intercalated in multiple arc in each of the branch wires g g'. The resistance of the primary coils of these converters should be such that each branch circuit g g' will have a resistance equal to or slightly exceeding that of the entire main line. The secondary coils of the converters E' E' are connected in a local circuit L^4, which will have the capacity of maintaining a few incandescent lamps, sufficient, probably, to light the generating station or some adjacent apartment.

By this system, therefore, the circuit a may be used to feed arc lamps or other apparatus requiring continuous current, while the other branch can be utilized for the transmission of alternating currents.

Mr. W. D. Weaver, the assistant engineer of the U. S. Steamer "Omaha," now in Chinese waters, has been elected a *membre titulaire* of the French International Society of Electricians. Mr. Weaver is a contributor to THE ELECTRICAL WORLD.

Prof. Fleeming Jenkin.—It is understood that Mr. R. L. Stevenson, the well-known English author, is engaged on a biography of the late Prof. Fleeming Jenkin. The subject is one worthy any pen, and from such hands we may expect a biography that will become a classic.

Good Bye to the Rats.—The Birmingham, Conn., electric light station was overrun with rats until the superintendent had a happy thought. To wires attached to the dynamos he fastened bits of meat and scattered them about. The rats smelled the meat, nibbled, and—good-bye, rats.

Practical Electricity.—We have just received Prof. W. E. Ayrton's new book on *Practical Electricity*, being a valuable work intended to assist students in acquiring exact information on the subject by the royal method of experiment. It contains 516 pages and 180 illustrations, and is published at $2.50.

A New Dress.—Our contemporary, the *Sanitary Plumber*, of this city, comes to hand in new shape and with a handsome cover. The paper is a good one, is conducted with dignity and enterprise, and handles the topics of its special field in an able manner. It deserves all its success and more. We have always been glad to note the intelligence with which it treats on electrical matters coming within its range.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, March 29, 1887.

Mr. E. R. Knowles, of the Mutual Electric Manufacturing Company, York and Washington streets, Brooklyn, has just finished a new laminated armature for dynamos. It is composed of four parts, each part or segment being composed of thin sheets of soft iron one inch wide, bolted together the whole width of the armature. Over the core are wound 60 coils, or 15 on each quarter section. In case of trouble, the long bolt can be withdrawn, any quarter section can be exposed, and any defective coil can be slipped off without disturbance of the rest. A new coil is substituted, and the old armature is again ready to make its daily revolutions, settling down at once to business like the average South American republic, where revolutions are as much a matter of course as morning coffee and the after-dinner cigar. The armature is a good one. Mr. Knowles, with customary industry, has also just finished some new voltmeters and ammeters of very simple construction, having no permanent magnets, needing no calibration, and measuring a very wide range of current and E. M. F. The Mutual Company has secured control of Johnson's composition rubber box for batteries, specially those of the storage class. The composition is built up of some seven ingredients, and is said to be very cheap. The company has also the sole agency for Long Island for the Julien batteries, and expects to do considerable work with them in lighting, etc. This new class of work requires new appliances, and the company has already in operation apparatus for charging, etc., as well as for cutting out the lamps automatically on arc circuits, while such circuits are being used for motors and storage batteries. This strikes me as a very good idea, particularly as the lamps are cut out from the central station, without the necessity of sending men around to fix the circuit in shape for such additional day work.

I sometimes think that cables must make a tolerably good-sized item in the accounts of telegraph and telephone companies. The demand never ceases, but grows as the years go by. The magnitude of the industry was again impressed on my mind last week in looking at the big 277 conductor cable, No. 17 B. & S., at the factory of the India Rubber and Gutta-Percha Insulating Company, this city. This fat cable is for the Metropolitan Telephone Company's new building on Cortlandt street. It measures over all 2½ inches in diameter. I had the pleasure of seeing how it is made, from the time when the tin-plated wire receives the insulating rubber compound and rubber tape and, after passing through the vulcanizer, is stranded into a 37-wire cable. Seven of these cables are put on a big turn-table, and then, by means of a machine invented by Mr. W. M. Habishaw, they become the cable that swallows all the others, like the biblical rod of old. It is worth going a hundred miles to see those seven cables running upwards, disappear through a hole in the first floor ceiling, and then reappear at the opposite end of the third floor a full-blown 2½-inch telephone cable, capable of withstanding all the strains that may be put upon it by induction, lightning, rough handling, sky-splitting profanity, and the hurried conversations—ten in five minutes and in every tongue that has a dictionary—of this polyglot New York of ours.

Schumann & Co., John street, who have been exhibiting the fine picture of the "Russian Wedding," using Edison lights, are now putting in a like plant at Sypher's art store, Seventeenth street and Broadway.

The Sawyer-Man offices in Nassau street wear an air of bustle and drive that tells a tale of heavy new orders and of constant "whooping up" the factory to get those back contracts filled. The company is pushed to meet the demand for its system, and sees new business ahead for months to come. I met Mr. E. G. Bernard at the office last week, and learned from him that he had been hard at work filling up part of New York State with lamps and machines. He had any quantity of good references as to the satisfaction felt by purchasers, and "points with pride" to the plant put in for the Troy *Press*, of which that paper speaks in the highest terms in its issue of March 19.

It says: "The arrangement of the lights is such as to satisfy almost any requirement. The *Press* counting room will have, besides its chandeliers, both bracket lamps and movable desk lamps with flexible connections. The editorial rooms will be similarly equipped. The stationary lamps will, of course, furnish all the light needed, and in a satisfactory form for the press rooms and the job department. In the composing room, each "case" will have an electric lamp hanging on a horizontal bar, parallel with and above the top of the "case." This lamp may be moved to any point on the bar at the option of the type-setter. The composing room of the Troy *Press* is the only one using this arrangement, by which about 50 per cent. of light is saved, and which is put in by the Sawyer-Man Co. expressly for the *Press*. Bracket lamps will, of course, be used on the walls and on the pillars of the building in this room, so that the foreman, in making-up, will be as well off as if he had daylight for the last edition all the year around. The electric lighting system has been put into this office under the personal supervision of Mr. E. G. Bernard."

Mr. H. N. Curtis, representing the Thomson-Houston Company, with his offices also at 32 Nassau, has recently introduced that system at New Rochelle, N. Y., putting in 50 arc and 200 incandescents, with 1 arc machine and 2 incandescents. The steam plant was furnished by the New York Safety Steam Power Company, and comprises 100 h. p. engine and boiler complete. Mr. Curtis has also finished plants on the three Clyde company's steamers of 50 incandescents and one 6,000 c. p. search light for each. That search light is bound, in my opinion, to become quite popular.

Mr. C. L. Healy, of the Commercial Telegram Company, gives me the following item: "The decision in the hearing before the Patent Office examiners, in the long-contested case of S. D. Field vs. C. J. Wiley for priority of the patent, or issuing of the same, for a two type-wheeled printer, each wheel to be independent and controlled by one escapement, and means for locking one while the other is in use, has been given in favor of Field on every point. This is the foundation patent for the printer used by the Commercial Telegram Company, and is a decided victory over the Western Union Company, who control the other interests."

Mr. A. A. Robbins, office 242 Pearl street, reports business good. He makes a full line of battery materials—pottery and glass, feldspar, fluor spar, manganese, oxides of cobalt, zinc, lead, etc.

Mr. A. Wirschung, of Centre and Duane streets, is busy on a large quantity of registers for the Stock Quotation Telegraph Company, 7 Nassau street. The company furnishes quotations of all kinds, and is organizing similar companies in other cities.

There are no establishments in this city where finer and more varied electrical work is done than the factory of S. Bergmann & Co., corner of Seventeenth street and Avenue B. I had occasion recently to visit this large five-story establishment and was shown through all its departments. While devoted largely to the manufacture of fittings for electric lighting on the Edison system, the works are equipped for all kinds of fine product and thus we see a variety of work performed here. I started my inspection upon the top floor. This was formerly used as the private laboratory of Mr. Edison, where I have seen some interesting experiments made in times past. Now, however, it is devoted almost entirely to the manufacture of the Hammond type-writer. This is a most ingenious machine and has the great merit that any font of type in any language can be printed by the machine. This is made possible by the fact that the type are on the periphery of a hollow cylinder which can be slipped off and replaced by another of different style. There are a number of good points about the machine, which is finished in elegant style. Where such exactitude of operation between parts is required, it is needless to say that the machinery employed is of the finest nature.

Another part of the same floor is occupied by the tool-makers who are just now getting out pattern and jigs for a new Edison lamp socket of simple and efficient design. Here also are put together the feeder equalizers to be used in central station for maintaining constant potential in the various parts of the system. These feeder equalizers consist of resistances which maintain the relations between lamps and feeder equal at different loads. They consist of heavy steel wires, which are joined and connected to a regulating switch, so that more or less length of wire can be inserted in the circuit. Strange to say steel is employed, as it is *cheaper* than iron wire.

Descending to the floor below I found Mr. Ch. Wirt in his testing room, standardizing the various galvanometers, ampère meters, etc., made in this department. It may not be generally known that some of the finest instruments for the use of colleges and schools are made here, and I saw a number of fine samples of the work. We need, therefore, hardly any longer go abroad for our reflecting galvanometers, Wheatstone bridges, discharging keys, etc., all of which from the most delicate instrument for indicating a current to the ammeter for measuring 1,000 ampères, are constructed here.

On this floor also the electric light fixtures, etc., are assembled. Here also is the sample room, where thousands of globes of all sizes, colors and shapes are arranged for easy inspection.

On the third floor we find the polishing, dipping and plating rooms, where the brass work receives its beautiful lustre, The pattern room occupies a part of this floor also, and the large electroliers are put together. While I was passing through, several were in course of construction, among them one for Mr. D. O. Mills. It is needless to say that it was a work of art.

As I stated before, these works are capable of undertaking any kind of electrical work, and hence we find an arc lamp also among its products, which is designed to be put on incandescent circuits.

Descending still another floor to the second, I find a variety of operations going on. Here the clatter of the stamping machines may be heard all day as they stamp out the blanks which later form the lamp sockets, switches and parts of other apparatus.

An important part of this floor is devoted to the manufacture of stock printers, all the instruments for the Western Union, Gold and Stock and the Commercial Telegram Companies being made in this factory.

On the first or ground floor the offices are situated, together with the packing rooms. In the rear are situated the engine and boiler and a brass foundry in which all the brass work for the electroliers is cast. I must not forget what may be termed the art department of the establishment, viz., the room devoted to the designer, Mr. G. Sickenberger. This gentleman designs all the new electroliers and ornamental work and some of his water colors are fit to be hung in an art gallery.

The factory, which is under the personal supervision of Mr. Sigmund Bergmann, employs between 400 and 500 men and is so crowded with work that an extension of the building is contemplated.

Mr. J. A. Seely, the energetic and ever active electrician of the Metropolitan Telephone Company, has just finished transferring one of the sub-exchanges of 700 subscribers, down town, concentrating and combining it with another. He has also had his hands full with work on the new headquarters.

The Kookogey Electric Manufacturing Company, 18 Dey street, will devote its attention to electrical specialties. Mr. Kookogey has lately had a number of patents granted to him, on chromic acid batteries. The company has 32 styles of these batteries for electric lighting, running motors, electroplating, etc. The use of this primary is said to be practical for incandescent lighting for from 1 to 25 16 c. p. lamps. The capacity of each cell is 2 volts and from 10 to 1,500 ampère hours. An exhibition of the batteries is now open to all at the Dey street salesrooms, where you can learn how to illuminate your parlor, bedroom or hall and other small areas. Some very pretty fixtures in floral designs are displayed.

W. R. Ostrander & Co., of 21 & 23 Ann treet, have just issued the fifth edition of their catalogue of electric bells and supplies, gongs and bell hanger hardware in general. The firm, who have a nice new factory on DeKalb avenue, near Knickerbocker, Brooklyn, are very busy, and are working their hardest to fill orders.

I have the following from Westinghouse, Church, Kerr & Co.: The Westinghouse Machine Company has made recent shipments to electric light companies as follows: South Side Electric Light Company, Pittsburgh, Pa., two 150 horse-power. Brush Electric Light Company, Buffalo, two of 60 horse-power (twenty-first order). The East End Electric Light Company, Pittsburgh, Pa., two 75 horse-power (third). Hartford Light & Power Company, Hartford, Conn., two 60 horse-power. Jefferson City Electric Light Company, Jefferson City, Mo., 60 horse-power. Wahoo Electric Light Company, Wahoo, Neb. Portland Electric Light Company, Portland, Oregon, four of 60 horse-power (seventh). Litchfield Electric Light Company, Litchfield, Ill., 100 horse

power. Cleveland Electric Light Company, Cleveland, Ohio, 75 horse-power (seventh). Canon City Electric Light Company, Canon City, Colo., 60 horse-power. Olney Edison Electric Light Company, Olney, Ill., 60 horse-power. Jenney Electric Light Company, Fort Wayne, Ind., three of 15 horse-power. The new Westinghouse building for the joint offices of the various Westinghouse companies in Pittsburgh is being rapidly pushed. It will be fire-proof throughout. It has a floor plan 80 by 110 and is 200 feet in height, with three high-speed passenger elevators. It will be lit throughout with incandescent light and warmed by indirect steam radiation, with natural gas as the fuel. It will be occupied exclusively by the offices of the various Westinghouse companies.

Mr. E. T. Copeland, of the New York Safety Steam Power Company, 30 Cortlandt street, invented and patented lately, as noted briefly in your patent record, a fire extinguishing apparatus, entirely automatic in its action. As now designed, it comprises a water valve held by soft solder, which will melt at any degree of temperature fixed upon. Suspended under the valve is a small vessel containing inflammable materials, through which an electric conductor passes. When the thermostats situated in any part of the building close the circuit, on the breaking out of a fire, the current as it passes through the small vessel renders the wire incandescent, thereby firing the inflammable material, melting the solder and releasing the valve. The apparatus is evidently very ingenious and practical.

Hazazer & Stanley, whose new annunciator you illustrated last week, have a large number of orders and contracts in hand for wiring, bell work, etc. They are fitting up the Railroad Men's Reading Room, Forty-fourth street and Madison avenue; the residence of Mrs. Cyrus W. Field, Twenty-first street and Lexington avenue; the residence of Ogden Mills, Sixty-ninth street and Fifth avenue, and two large buildings for Lamb & Rich, the architects; a large apartment house at Eighty-ninth street and Second avenue, and a residence for Mr. Sanford, 812 Fifth avenue, the latter being wired complete for call-bells, burglar-alarm and electric gas lighting. W. T. H.

PHILADELPHIA NOTES.

PHILADELPHIA, Pa., March 29, 1887.

Citizens here are anxiously awaiting Professor Edgerton's promised exhibition of a street car propelled by his company's electric motor. Experiments on his miniature railway adjoining the office, at the corner of Thirteenth and Market streets, have proven so successful that the promise referred to seemed well warranted. Not only has this motor attracted attention here, and throughout this country, but inquiries are coming in from parties in Europe, the best present answer to which is, that this company's complete outfit is already on its way to the American Exhibition. The new catalogue, expected April 1, is already on their table, containing, besides illustrative cuts and explanations, several most emphatic testimonials from those who have purchased and are using them; one being from the proprietor of two printing presses driven at the same time by an Edgerton motor.

At the last meeting of the City Council, the late grant of privilges to the Penn Electric Gas Light Company was so amended as to explain that no privileges were intended to be given to one company that were not readily obtainable by others.

The Westinghouse Company have fully determined to change their "direct system" to the alternating as soon as the machinery can be prepared. Meantime they wish it understood that their company has no relations whatever with the Standard Oil Company, as interested parties have hinted.

Philadelphia has resolved in council to place 152 additional arc lights in different parts of the city. The order will go to the various companies now operating.

Much interest was manifested in the paper read by Prof Elihu Thomson, before the Franklin Institute last Wednesday evening, on electric welding. The Professor is the inventor of the process, which has already been illustrated and described in the columns of THE ELECTRICAL WORLD.

In 1886, Philadelphia appropriated $2,500 to test underground electric light service. In the report of David R. Walker, chief of the City Electrical Department, made one week ago, it was stated that 5,200 feet of six-wire anti-induction cable was laid along Broad street, from Columbia avenue to the Reading Railroad, under the sidewalk at a depth of one foot, under crossings two feet. The conduit is 2 by 2½ inches inside, of 1 inch spruce. The line was subsequently continued with 1,500 feet of Tatham & Brothers' test cable to the corner of Park and Lehigh avenues. Both cables have worked with entire satisfaction, and neither has been out of service during the year. The cables were carried up through wrought iron posts twenty feet high to the lamps. The report is condensed finally into the short sentence: "This service has worked without any failure or stoppage."

It seems that the telegraph, telephone and electric light companies have made no effort to put their wires underground. The amount due from these to the city is $23,486.50, of which a little over one-third has been paid into the treasury, and the remainder is in the hands of the City Solicitor for collection.

At the opening of the present year there were 5,053 poles on the city highway, besides those for railroad use and those belonging to the city, and 4,490 miles of telegraph and telephone wire. The whole amount of conduit laid in the city is 19,963 feet, and the amount of wrought iron pipe, 1¼ and 2 inch, through which single wire was drawn, was 21,347 feet. During 1886, 250 permits were issued for poles, wires and repairs, but only for the extension of electric light service already authorized. At the close of 1886, there were 354 electric lights; 156 having been placed during the year. The average cost of their maintenance has been 53⅛ cents per night; 737 lamps have been displaced by these electric lights. Chief Walker reiterates the recommendation made at the close of 1885, that these lights be extended to the entire city, and now adds the recommendation that the city should own its plant for the purpose. There are now in the city 389 fire signal boxes, 36 having been added during the year, and it is recommended to increase the number to at least 500. The city and county are using 247 telephones. The number of police wire messages transmitted was 235,680. The number of fire-alarms was 466.

There are now in use in the city 4,000 arc lights and 20,000 incandescent lights, the former being used for outdoor and other large area lighting, the latter for indoors.

Although constant apprehension of danger is felt by many, in view of the intensity of the arc current and the increasing multitude of incandescent wires, the conclusion is, after very careful consideration of all the liabilities, that these apprehensions should be entirely groundless with a proper system of supervision and inspection.

The Foundry and Machine Department of Harrisburg, Pa., have shipped to the United States Electric Light Company at Washington City five 100 h. p. steel return tubular boilers; also two 70 h. p. engines and steel return tubular boilers and complete power plant to the Excelsior Electric Light Company, of Harrisburg. Boilers furnished in connection with engines have all been set with the Whitmoyer patent dirt-burning furnace.

Mr. H. M. Sciple, of 100 and 107 North Third street and 301 Arch street, a mechanical engineer of high repute and one of the heaviest boiler and engine manufacturers in Philadelphia, has for some time past been paying special attention to the subject of electric lighting. He has now erected a fine plant of the Indianapolis Jenney system in his large offices at Arch street, and has undertaken the agency of the system which, after the most careful test and inspection, he has formed the highest opinion of. Mr. Sciple will no doubt make a good showing of orders in his territory. He has evidently the greatest faith in it, as he also intends to put in an isolated plant at his residence, Bordentown, N. J.

A number of prominent telegraphers and electricians held a meeting last week, at Spartan Hall, Sixteenth and Filbert streets, and permanently organized themselves into a society for scientific, social and literary purposes. I have already given you details of this matter. A constitution was adopted and the following officers elected: President, J. B. Fleshman; Vice-Presidents, M. D. Law, H. T. Paulhamus, D. A. Curl; Treasurer, A. F. Reed; Secretary, D. R. Gibbs, and a Board of Managers. Letters and telegrams were received from bankers, business men, telegraph and electric light companies, promising their support. Several handsome contributions were made. A meeting of the Board of Managers will be held to perfect arrangements to secure permanent apartments. Mr. M. D. Law, of the Brush Company, who has been elected deservedly to high office says: "Our design is to start a good club, and as soon as possible to secure a permanent room and library which will be open at all times for the use of members and their friends. Our regular meetings are to be held on the first Tuesday of each month, when there will be papers read and debates on the different electrical subjects, or some other good entertainment Credit is due the B. & O. telegraph employés for starting the organization." Mr. Law says, by the way, that the Brush Company's own benefit organization is doing well. The meetings which he is conducting, with lectures, have now got as far as the principles of the dynamo machine. D.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, March 29, 1887.

The Malden, Mass., Electric Light Company has made a proposal to the authorities of Medford to light the streets of that town with electricity for one year for $8,000.

The Colby University, Waterville, Me., is reported to have just made arrangements with the new Waterville Water Company to furnish the chapel and dormitories of the former with electric lights and water.

The Middletown, Conn., Electric Light Company has voted, it is said, to install a 1,500 light incandescent (Edison) plant. After the incandescent equipment is set up, the arc-light department (Schuyler system) will also be enlarged.

Kennebunk, Me., is to have another manufacturing enterprise, and ground has already been broken for the laying of the foundation of a large carbon factory. The new concern was recently incorporated under the name of The Hub Carbon Company, with a capital stock of $600,000.

The Newburyport (Mass.) Electric Light and Power Company, and the Brunswick (Me.) Electric Light and Power Company have been incorporated. The capital stock of the former company is said to be $15,000, while that of the latter is set down at $7,000. Reference was made to the first-named company in THE ELECTRICAL WORLD, March 19. The latter has adopted the Brush-Swan system.

The following order was presented to the Boston Board of Aldermen at the meeting on March 24: That all the rights and privileges granted to William R Clark, Charles W. Lewis, John F. Shorey, Frederick Allen, Alfred A. Nickerson, S. O. Richardson, and Cyrus Wakefield, to construct and maintain wires under ground, contained in an order passed by the Board of Aldermen, Dec. 27, 1881, be and the same are hereby transferred to the American Conduit Company, under the same conditions and restrictions that are set forth in said order. Referred, on motion of Alderman Lee, to the Committee on Underground Wires.

Advices from Providence, R. I., report that the stockholders of the Providence Telephone Company met March 24 to take action in regard to the amendment to its charter looking to an increase of its capital stock and the distribution of the stock to the American Bell Telephone Company in consideration of an exchange of its limited franchise for a perpetual one. At a recent meeting the directors passed among others the following motions, and the stockholders' object was to concur with the board of directors and pass these votes. The motions in question were:

That the amendment to the charter granted at the January session, A. D. 1887, authorizing an increase of capital, be and is hereby accepted. That the capital stock of the corporation is hereby increased to $384,600 for the purpose of effecting an exchange of the limited franchise for a perpetual one. That the additional stock hereby created be issued under the direction of the board at not less than par. At present the stock is quoted at $120 on a par of $50.

The stock pays 20 per cent now. The franchise expires in January, 1889, and until that time the stockholders continue to get 20 per cent., and after that they get nothing. Not only the dividends, but the principal will be gone. If the company decided not to make this contract the stock would drop at once to about $70. On the question being put as to whether it were better to have 20 per cent, dividends for two years only, or have less and have the company go on ad infinitum, it resulted in the votes of the board of directors being unanimously approved.

In an interview recently had with Mr. Wm. J. Hammer, manager of the central station, on Head Place, of the Edison Electric Illuminating Company, of Boston, my interlocutor said: "Our new station is rapidly approaching completion. The entire walls of the building are up, and all the flooring, ceiling and concreting in half of the building is completed. Six of the 15½ × 15 Armington & Sims engines are in place, and have been adjusted and turned over. Four of the 400 ampère machines have been set in place and belted up to the engines. Four others are now being put in place, and early next week four more will be set up, making in all the first installation of twelve 400 ampère machines. The temporary connections are now being made to the conductors in the old station building, in order to run the lights from the new plant and enable the company to tear out the eight old dynamos and four engines in the present station to make room for the setting of the fourteen boilers which are to be single return steel tubular boilers with Jarvis settings. A small section of the underground conductors has already been connected, and three-quarters of the underground system, which comprises between five and six miles, has already been completed. It is proposed as soon as this system shall be completed that the lights on the overhead shall be transferred to the underground system, leaving all the Sprague motors connected to the overhead system; after which an elaborate test will be made to ascertain the exact volume of current required in the electric transmission of power from this station, which is the most important station for the electric transmission of power in the world, and comprises already between forty and fifty motors, ranging from one-half to ten horse-power.

"The larger types of motors are run on a 220-volt circuit, employing the two outside wires of the three-wire system; the smaller ones being run in simple multiple arc on one side of the system. The Edison Company have motors of 5, 7½ and 10 horse-power, operated at the following distances from the station: 1,700 feet, 2,200 feet, 3,561 feet, 3,600 feet, 4,285 feet and 5,300 feet. These are found to work in a perfectly satisfactory manner, and give practically no trouble with the regulation in the station. This result is attained by the automatic regulation of the Sprague motor and by the proportioning of the copper in the system, and placing the motors on the two sides of the three-wire system; and in the case of large motors at long distances, by connecting them to both outside wires of the three-wire system. The day load at the present time amounts to 650 ampères between the hours of 8 and 12 o'clock, showing that while there is a very slight amount of day load, there is a large amount of current employed for the electric transmission of power. As it is absolutely essential to run a station of any size through the 24 hours, many stations which are at the present time on a non-dividend paying basis, or paying but a small return for the investment in the business, could be made an excellent paying enterprise by taking up this question of electric transmission of power during the day time. The Boston Edison Company have at the present time an increasing demand for the Sprague motor, and it is expected that at an early date the number of motors will be nearly doubled. The confidence of the general public in the reliability of the motor has been secured, and its convenience and economy demonstrated. The motors are connected directly on the overhead system, the same as the lights, and on the same sets of wires; although originally nearly all these motors were placed upon a separate power line. It is therefore a difficult thing to ascertain exactly how much power is utilized in running motors. But as soon as the lights are transferred to the underground system, as before stated, a test will be made to ascertain exactly how much this is and what is the cost. Since the first of January the Edison Company has installed 2,007 new lamps. Among the most important of these installations are the following: Somerset Club, 513 lights; Boston Whist Club, 52; Central Club, 16; Park Street Church, 52; Clark's Hotel, 150; McKinne & Co., 125; Globe Theatre, 200 (additional); L. P. Hollander & Co., 486; Bryant & Stratton's College, 85. These additions make upwards of 7,013 lamps which have been connected since the inception of the station, which started up on the 20th of February, 1886, with 711 Edison lamps. A portion of the buildings which are now being wired up for the Edison light will not be supplied with the light until the machinery is running in the new station, which will immediately have a capacity of 10,000 lights and an ultimate capacity of 40,000 lights. The underground system, which is now nearly completed, is the regular Edison three-wire underground system, utilizing also three flexible feeders in addition to the Edison cable feeders manufactured by the Callender Insulating and Waterproofing Company, similar to those furnished by them for the Edison station in New Brunswick and elsewhere. In the arrangement of the electric details of this station, a number of new departures will be taken from past methods of arranging the details of a station. It is intended that this station shall be made, mechanically and electrically, one of the best electric light plants in the United States. As indicative of the enterprise of the parties interested in the Boston Edison Company, and their confidence in the financial status of the Edison central station business, it is interesting to note that on Saturday, March 19, the cash was paid down for a piece of real estate of nearly six thousand square feet, in the North end of Boston, for the establishment of a second Edison station, the plans of which are now being prepared and work upon which will be commenced immediately. This new station will be somewhat after the character of the new station now being installed in Head Place, off Boylston street., and will take up the question of electric transmission of power on a still larger scale."

The Wainwright Manufacturing Company, 65 and 67 Oliver street, Boston, have been awarded the bid for a feed-water heater of large dimensions to be erected in the extensive Edison plant soon to be put up in Japan.

The Jarvis Engineering Company has received a contract through the Edison Company to set five tubular boilers with the Jarvis boiler setting in the Edison Illuminating Company's station, to be erected in Tokio, Japan. The Sheffield grates, to burn coal screenings for fuel, will be used. This class of fuel is all wasted in Japan. While good coal costs $7 a ton, screenings can be obtained for the cost of loading and freight. This company has also received the contract to construct the new electric light sta-

tion for the Newburyport (Mass.) Electric Light Company. The boiler will be made of steel and set with the Jarvis furnace, to use Sheffield grates, to burn screenings and culm coal for fuel; and the plant will also comprise the National feed water heater, Shepard power pump and Korting injector.

A Buzzard's Bay, Mass., dispatch says, that owing to trouble between the Western Union Telegraph Company and the French Cable Company, a gang of linemen employed by the latter company is engaged in putting up new wires and opening up offices between the station at North Eastham, Mass., and New York City, and it is understood will arrange to compete with the Western Union for local business. W. I. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, March 26, 1887.

The Central Electric Company, who have just opened up in Chicago, at 38 and 40 La Salle street, have issued to the trade a circular (a copy of which, I believe, appears in your advertising columns). They announce themselves as manufacturers and dealers in telegraph, telephone and electric light supplies, electric bells, burglar alarms, house and hotel calls, annunciators, etc. Mr. W. H. McKinlock, formerly of the Detroit Electrical Works, is secretary of the company. His brother, Mr. George A. McKinlock, is treasurer, and Mr. M. T. Greene is president.

As an instance of the substantial work which goes into the switch-boards built by the Western Electrical Company, I might state that a test was recently made at the factory to see how much actual service the plugs and spring-jack springs used in connection with these boards would stand. The plug and spring were selected at random from a lot ready to go out, and were worked by machinery 11½ hours at the rate of 128 connections per minute, or 88,320 connections in the 11½ hours. If we figure that each plug and spring is used on an average to make 20 connections a day the above test would be equal to over 14 years of actual service. Neither the plug nor the spring showed any appreciable wear after this lengthened test.

The Leavenworth (Kan.) Coal Company are running a Heisler plant of 160 lights for private customers. The supply of power is three miles distant from the city, where they take direct from a coal pit, and hence get fuel about as cheap as it can be had anywhere. The company now propose to light the streets of the city, and have given the Heisler Electric Light Company, of St. Louis, an order for a 400-light machine, expressing their satisfaction in the following testimonial, signed by J. E. Carr, general manager, and W. B. Walker, electrician: "The result of the Heisler machine, after running five months, has been so satisfactory that we have ordered another of 400-light capacity. The final test of our present machine shows a consumption of 22½ h. p. to 160 30 c. p. lights." The Heisler Company have now installed plants at Ottawa, Kan., Leavenworth, Kan., Monticello, Minn, Vincennes, Ind., and St. Louis, Mo., and will in a very short time put up plants of 1,000 lights each in Salt Lake City and Ogden City, for the Brush Companies in those places. The plant at Monticello belongs to Mr. W. F. Brown, who is well known in the incandescent business West. The financial success of the plant has been remarkable, considering that Monticello is a place of only some 600 inhabitants. It seems to me that more of these small town plants might be installed with success and profit.

Two very important street franchises for lighting have just been granted, one at New Orleans and the other here in Chicago. The New Orleans ordinance is a radical innovation in this matter of granting permission to run wires. The ordinance sets forth that since the whole present system of running wires on poles is a danger and a nuisance, a special right for fifty years has been given to Maurice J. Hart, or his representatives, corporate or other, to erect in the streets, etc., "a system of towers or supports for the purpose of carrying all wires and cables, whether for telephone, electric light, telegraph or other electrical purposes," under the supervision of the Commissioner of Public Works. The lower wires are not to be less than ten feet above the roof of the buildings near which a tower is located. The towers are to be divided into sections, each section being devoted to a special class of wires. The grantee is given the right to fix a price "not exceeding $500 per mile for a horizontal section or division of three by five feet upon every tower and support within said mile for occupation by not more wires or cables than shall together be of the weight of 100 No. 10 wires American measurement (say B. & S.), and no person shall claim or demand any right to have a less price for a smaller space or less weight." Hart is to pay the city 5 per cent. of the annual profits of the business, to provide free of charge fire hose or pipes run up on each of the towers, and to allow the city to use the towers for all its own wires without cost. It is further provided that any electric light company now or hereafter having the right to put up lamps, shall be empowered to place lamps on the towers at an annual rental not to exceed $5 per lamp. The companies owning pole lines are to remove them. It will be seen from this synopsis of the provisions that a new departure of the first importance has been made. New Orleans will no longer be known as the Crescent City; her new name will be that of the Tower City. A contract has already been placed with the Star Iron Tower Company, of Fort Wayne, Ind., for 224 towers, to be used in keeping with the terms of the ordinance.

The Chicago ordinance is in behalf of the Western Edison people, who are authorized by it "to construct and maintain in the streets, alleys, sidewalks, tunnels and public grounds of the city of Chicago a line or lines of wire or other electric conductors, to be used for transmitting electricity for the purpose of light, heat, power and signals * * * all such lines, except when they pass through tunnels, to be underground."

The Electrical Supply Company, 171 Randolph street, Chicago, report a steady increase in their business. Their chromic acid for primary batteries, mention of which was made a few weeks ago in these notes, is meeting with a phenomenal success, and, the company say, to judge from the unqualified expressions of satisfaction received from customers, is the long-looked-for ingredient to make the use of primary cells for operating small incandescent lamps, motors, etc., a success. The demand for their improved testing sets, voltmeters and ammeters, etc., remains undiminished.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes me the following telephone stock quotations:

Bell of Mo.	$155@$157
Central Union	54@ 55
Chicago	375@ 400
Colorado	20@ 22
Cumberland	80@ 85
Great Southern	30@ 33
Michigan	72@ 73
Rocky Mountain Bell	40@ 45
Wisconsin	104@ 106

W. A. K.

THE TELEGRAPH.

Claremont, N. H.—A bad fire occurred at Claremont on March 26, destroying the telegraph office and telephone exchange.

Messages for The Kaiser.—The Emperor of Germany received 1,648 telegrams on his birthday anniversary, of which 60 were sent from the United States and 5 from Canada.

Cable Steamer in Port.—The cable steamer "Minia," Capt. Trott, has been lying in the harbor of East Boston for some days. She has just repaired a break off Brown's Bank and proceeds to London.

THE TELEPHONE.

Erie Dividend.—The Erie Telephone directors have declared a quarterly dividend of one-half of 1 per cent., payable April 25 to stock of March 31. Books re-open April 11. The dividend will be mailed by check.

Buffalo, N. Y.—A dispatch of March 21 from Buffalo, says: In accordance with a compromise between the citizens' committee and the telephone company the cable of the latter on Main street was taken down this morning.

Mr. Henry Guy Carleton had a long and humorous article in the Sunday *World* on the delights of a telephonic conversation at a public station. He suggests that the company tune up the instruments occasionally or else furnish the clerks in charge with a cast-iron spring suit.

Charleston, S. C.—The Charleston exchange is now in full operation again after its transfer, and, according to the local paper, Mr. Easterlin is quite satisfied with the way things are working. He has been giving the subscribers some first-rate advice through the journals.

The Buffalo Agitation.—The business men of Buffalo, who held a great mass meeting under the influence of the awful Richmond hotel fire, to demand the burial of the telephone and telegraph wires, have discovered that this will be a labor of time, and they are now insisting that the wires be raised upon high poles above the tops of the buildings until the underground conduits are ready.

A Defeat for Pan-Electric.—A dispatch from Baltimore of March 25 says: In the case of the American Bell Telephone Company *et al* against the Pan-Electric Telephone Company and others, Judge Morris, in the United States Circuit Court, to-day, passed an order that the defendants be adjudged guilty of contempt of the order on injunction issued by the court July 19, 1886, and directed that they forthwith deposit with the clerk of the court all the transmitters and receivers, including the boxes which contain them, in accordance with that order, and that they pay a fine of $100 to the complainants.

A Good Yarn.—A special from Orange, N. J., of March 22, says: Three big poles of the New York & New Jersey Telephone Company fell early this morning at the Lumber street crossing of the Delaware, Lackawanna & Western road, owing to the weight of the snow. Several hundred wires fell across the track in front of the fast freight. The engineer whistled brakes, but the train could not be stopped, and the engine ploughed through the tangled wires. They wound themselves around the engine, tore off the headlight, smokestack, whistle and bell, and all the ornamental work, and when the train stopped finally there were over 40,000 feet of wire about the engine and cars.

Bell Output.—The instrument account for the month to March 20 is a good one, and maintains the average gain. The figures are:

Month March 20.	1887.	1886.	Increase.
Gross output	4,372	2,819	1,553
Returned	1,452	1,232	220
Net output	2,920	1,587	1,333
Since Dec. 20.	1886-7.	1885-6.	
Gross output	11,751	8,882	2,929
Returned	5,326	4,188	1,138
Net output	6,425	4,634	1,791

THE ELECTRIC LIGHT.

Mankato, Minn.—A plant is to be put in by Mr. F. L. Watters.

Newton, Ia.—Mr. H M. Vaughan and C. H. Wilder will put in a plant at Newton.

San Antonio, Tex.—The Hammond-Sutton Electric Light and Power Company was lately formed at San Antonio.

Johnstown, N. Y.—The Johnstown Electric Light and Power Company has been organized with a capital of $20,000.

Warsaw, N. Y.—The Pennsylvania Gas Company, Jamestown, Pa., proposes to put in an electric light plant at Warsaw.

France.—It is stated that the Edison Company intends putting in a large station on the Zipernowsky-Deri alternating system.

Northampton, Mass.—The Northampton Electric Light Company have purchased a new Armington & Sims Company engine.

Meyersdale, Pa.—The plant for the Electric Light and Power Company, Mr. R. L. D. Meyers, secretary, will cost about $15,000.

Massachusetts.—The lawmakers of Massachusetts have before them a bill placing certain restrictions on gas companies that wish to undertake the additional business of supplying electric lights.

McKeesport, Pa.—The National Tube Works at McKeesport, Pa., have put in a 125 horse-power Westinghouse engine for electric lighting.

Pratt, Kan.—The Pratt City Electric Light Company has been incorporated by H. H. Campbell and others, with a capital stock of $25,000.

Carlyle, Ill.—The Carlyle Water, Light and Power Company has been incorporated by G. Tilden and others, with a capital stock of $20,000.

Construction.—The Advance Electric Construction Company, St. Louis, Mo., formed by Mr. A. J. Frith and others, has a capital stock of $10,000.

The Gibson Electric Company, of Minneapolis, Minn., has been formed and incorporatedby T. S. King and others, with a capital stock of $100,000.

Railway Car Lighting.—The Long Island Underground Electric Light Company will equip a car on the New York Central with their primary battery system.

Connellsville, Pa.—The Advance Electric Light Company, of Connellsville, has been incorporated. Mr. S. H. McCabe, of Mansfield, Pa., has been made treasurer.

Carbons.—The Hub Carbon Company, of Kennebunk, Me., has been formed with Mr. Luke A. Wilder, of Chicago, as president, and with a capital stock of $600,000.

Doylestown, Pa.—The Doylestown Electric Light Company, in which Mr. A. Paschall is prominent, is about to incorporate and to put in a plant to cost about $10,000.

Brunswick, Me.—The Brunswick Electric Light and Power Company, which has incorporated with a capital of $7,000, has Mr. A. F. Gerald, of Fairfield, Me., as president.

The Elmira Reformatory.—The contract for lighting the Elmira, N. Y., State Reformatory, secured, as stated last week, by the Brush Company, is for the sum of $17,000.

Cleveland, O.—The Cleveland Electric Light Company are still further increasing their plant, and have added another Westinghouse engine of 75 horse-power, making seven in all in that station.

Buffalo, N. Y.—The Brush Electric Light Company, of Buffalo, have now twenty-one Westinghouse engines of 60 horse-power each in their station, all in a single room operated by one attendant.

Fort Worth, Tex.—The Texas Telephone, Light and Power Company is a recent organization at Fort Worth, in which Mr. J. G. Watkins is interested. Its name suggests the Hutchinson, Kan., combination.

Bridgeport, Conn.—Messrs. Warner Bros., Bridgeport, Conn., have purchased of the Jarvis Engineering Company, a 50 horse-power Armington & Sims engine, to be used for power in their mill and to run electric lights.

Portland, Ore.—The Portland Electric Light Company, Portland, Ore., having made a success of arc lighting, have decided to go largely into incandescent lighting. They have contracted for four 60-horse Westinghouse engines, making seven in all.

Edison Lights for Japan.—The Edison Company have closed with Messrs. Fujioka and Yashima a very large contract for electric lighting in Tokio. The central station will supply several thousand lights, a large number of which will be used in the Mikado's palace.

The Woods Electric Company has been organized at Covington, Ky., by J. A. Gano, G. T. Woods, J. M. Clark and J. E. Hamilton. The capital stock will be $1,000,000, divided into shares of $50 each. The company will manufacture and sell electrical devices and appliances.

New York City.—The New York Lighting Company has filed its certificate of incorporation. Its capital stock is $150,000, and objects are the manufacture and use of electricity for light, heat and power. The incorporators are Heman Clark, Thornton N. Motley, Michael H. Cardozo and Charles J. Fiske, who, with Jordan L. Mott, Jr., are also trustees.

Westinghouse Plants.—The Westinghouse Electric Company represent the demand for the alternating system as very active. They closed contracts during January and February for fourteen central stations and as the working months come on, business grows still more active. It is reported that the company will use the system for isolated plants, even those of moderate size.

East Boston, Mass.—The directors of the Citizens' Electric Light Company of East Boston and Chelsea have decided upon the erection of a new building on the site of the one burned a few weeks ago in East Boston. It is to be one story and measuring 32×24 feet. The new structure will be considerably larger than the one recently burned, as the business of the company is extending rapidly.

Stopping the Dynamo.—People next door to Harry Miner's theatre on West Twenty-sixth street have obtained an injunction compelling him to forego the use of his electric light plant, on the ground that the noise annoys them and that he uses their wall for floor supports instead of having a wall of his own. Mr. Miner should get around his trouble by using storage batteries, charging them himself in the day time.

Dodge City, Kan.—Among prevalent methods in electric light stations is that of connecting two engines together by means of an extended shaft with jaw couplings on the hub of the wheels of the engine, which connect the shaft with the same by means of clutch couplings, enabling the attendant to release either engine at will. The Ball Engine Company, of Erie, Pa., is sending a pair of engines thus coupled to the Thomson-Houston Electric Light Company, Dodge City, Kan.

Lighting the Dark Continent.—Mr. C. H. Disbrow, of the Fuller-Wood Electric Light Company (Limited), has sold and shipped during the past week a complete plant for the missionary steamer that is going up the Congo River, to Stanley Pool, South Central Africa. The light is thus penetrating the remotest recesses of the Dark Continent, and in conjunction with other teach

ers of morality and civilization, will throw its genial beams upon the dusky natives there. It is the pioneer light to enter such territory, and will beyond doubt prove extremely useful in a variety of ways. No missionary steamer is fully equipped for its work without an electric light plant.

APPLICATIONS OF POWER.

Jacksonville, Fla.—The Pine Street Railroad Company proposes to adopt electricity.

St. Joseph, Mo.—The Union Street Railroad Company is preparing to operate by electricity.

Atlanta, Ga.—The Metropolitan Street Railroad Company is reported likely to adopt the Van Depoele system.

Chicago, Ill.—The Chicago West Division Railway Company will experiment with electricity, as a motor, on California and Armitage avenues, Jefferson.

Allegheny, Pa.—Pittsburgh papers state that an electric railway, 3¾ miles long, is contemplated at Allegheny, to cost $225,000, and that Mr. O. P. Scaife, of Pittsburgh, is interested.

Lincoln, Neb.—An electric motor company has just been organized, in Lincoln, Neb., the object being to operate a passenger road from the business part of the city to the stockyards, the cars to be propelled by electricity. The capital stock is $100,000.

On Dental Engines.—A leading dentist in New Orleans writes us as follows: "As a matter of news, I would say that the first motor operated on a circuit (not by battery) in this city, and probably in the South, has just been installed in my office, capacity ⅛ h. p., with current from the Edison station. It is a C. & C. motor, and drives my dental engine. Ten days' trial allows me to say it is a success."

Applied To Shoe Machinery.—Mr. O. E. Lewis, manager of the Wire Grip Fastening Company, is exhibiting the fastener to the boot and shoe trade in Boston. It is run by a Sprague motor, which in turn derives current from a set of Julien secondary batteries in the office. The cells also operate the incandescent lamps in use there. Altogether this little exhibit, at 104 High, is a very striking evidence of modern ingenuity and progress.

New York State.—The Oswego *Palladium* has the following: We notice that our enterprising neighbors in Ithaca have just made a contract with the Daft Safety Electric Power Company for an equipment of their street railway, and that this will also enable them to distribute power wherever wanted in Ithaca for small manufacturers. It would be a long stride toward bringing manufactories to Oswego if we should follow Ithaca's example, converting some of our now wasted water-power into electric power, and distributing it wherever wanted in the city. We notice that the Daft Company guarantee the successful operating of their system, so that "will it work" is no longer a question that will be asked. We commend the subject to the notice of the Improvement Society.

Worcester, Mass.—The electrical and industrial exhibition at Worcester, operated by Daft motors, continues with great success. The attendance averages from 1,500 to 2,000 daily. The electrical apparatus is working very satisfactorily, and highly favorable opinions are being formed of the capabilities of the electric motor. It is said that the 60 h. p. Daft dynamo on exhibition is to be utilized for operating the "dummy road" by electricity this season.

Lancaster, Pa.—A correspondent in Lancaster informs us that the motor in use there doing heavy work—to which reference was made recently by our Philadelphia correspondent—is a 10 h. p. Sprague. "It is running successfully a set of 'feed' stones, and a freight elevator and conveyor, in addition to a grain elevator. We have also six ½ h. p. Spragues running coffee-mills, jewelers rolls and lathes, etc., and one is running 16 sewing-machines in the umbrella factory of Rose Bros. & Hartman. We have a 1½ h. p. Sprague at the same place running saws, drills and small elevator. One ½ h. p. is running a Gordon printing press, replacing successfully a 1½ h. p. turbine that was insufficient. Orders are booked for three more ½ h. p., which is not a bad showing for our young Edison station."

PERSONALS.

Mr. G. C. Sims.—The engagement is announced of Mr. G. C. Sims, of the leading firm of Armington & Sims, engine builders, Providence, R. I., to Miss Laura Brayton, youngest daughter of the late Lodowick Brayton, of Providence, R. I.

Mr. Edgar Fawcett, the novelist, has just published in *Lippincott's* a tale called "Douglas Duane." It is based on the idea that by the aid of electricity human life can be transferred to a corpse, and is worked out with much dramatic power. Some of the critics say that it follows closely the lines of a story by A. A. Adee, published seventeen years ago in *Putnam's*, in which one of the characters was able, by means of a magnet, to absorb life from a human being. At any rate, it is well worth reading.

Mr. R. S. Boyd, well known among telephone men as a special agent of the American Bell Telephone Company, is now believed to have lost his life in the fire at the Richmond Hotel, Buffalo. Messrs. W. A. Hovey and T. B. Doolittle, representing the company, have made a special investigation on the subject, and their labors make it clear that the unfortunate gentleman was in the building when the fire broke out and was never seen again. The sad news will be learned with deep pain and regret by Mr. Boyd's many friends.

MISCELLANEOUS NOTES.

Heat Controlling Apparatus.—The Chicago Electric Service Company has been formed by S. S. Badger and others, with a capital stock of $100,000.

Shock Machines.—The Automatic Electric Shock Machine Company, of Castleton, N. Y., incorporated by E. Holbrook and others, has a capital stock of $200,000.

T. M. B. Association.—Messrs. W. H. McDonald and C. S. Soule have been appointed agents of the association at Vincennes, Ind., and Omaha, Neb., vice Perry Hood and C. B. Horton, resigned.

Sioux City, Ia.—A prohibitionist was killed lately at Sioux City. The trial has brought out one important witness, who states that, though the night was dark and rainy, he saw some of the assailants by means of an arc light a block away.

A Body Finder.—A Professor Hayward has been searching on Staten Island with some electrical machine—induction balance apparatus, probably—for the body of a woman murdered and buried in a garden. So far no success is reported.

The Canadian Society of Civil Engineers has lately been organized at Montreal, and over 200 of the leading engineers of Canada have joined the society. We note that Mr. Gisborne, the government electrician at Ottawa, was elected, by ballot, as one of the council of the society.

They Read Their Telegrams in Court.—A cruel joke was perpetrated upon two Clearfield, Mass., barristers on St. Valentine's day. While in the midst of an exciting trial a couple of telegraph messengers rushed in, giving each lawyer a Western Union envelope. The case was stopped to give them time to read the telegrams, and naturally the attention of the whole court was attracted in their direction. When they unfolded their respective missives both were startled by a highly-colored comic valentine, representing a shyster lawyer. The judge smiled, the jury laughed aloud, and the two victims hurried through with the case and got out of court.

BUSINESS NOTICES.

Free to Electric Light Co. or any Engineer.—Enough "Eureka" packing to pack a box. Guaranteed superior to anything on the market. 75c. per lb. HINE & ROBERTSON, 12 Cortland St.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts, cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

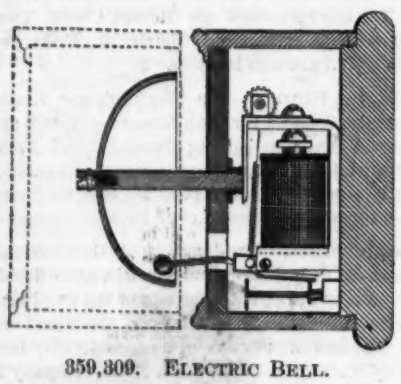
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED MARCH 15, 1887.

359,248. Positive Pole Plate for Secondary Batteries or Accumulators; S. Farbaky and S. Schenek, of Schemnitz, Austria-Hungary. Application filed Sept. 25, 1886. The invention consists in a particular construction and arrangement of the trellis-shaped lead frames, as well as in a particular distribution of the packing mass in the cells of the trellis. See illustration.

359,260. Combined Push-Button and Thermostat; F. Keffer and J. A. McDowell, Columbus, Ohio. Application filed July 8, 1886. The object of this invention is a simple and inexpensive apparatus having the functions set forth in the subject. See illustration.

(1) 359,306. Return Attachment for Telephone Toll Collectors; **(2) 359,307. Telephone Register**; **(3) 359,308. Telephone Register**; C. Wittenberg, Indianapolis, Ind. Assignor to E. G. Cornelius, of same place. Applications filed respectively Sept. 9, July 28 and July 29, 1886. (1) In this apparatus a coin must be deposited in the apparatus before the telephone can be used. (2) and (3) In these inventions the act of registering the number of times a telephone is used is performed jointly by the person using and the central office.



359,309. ELECTRIC BELL.

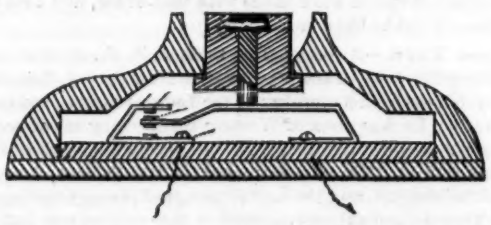
359,309. Electric Bell; F. B. Wood, New York, N. Y., Assignor to the New Haven Clock Co., New Haven, Conn. Application filed April 29, 1886. The design of this invention is to provide a bell which is dust proof, simple and compact in construction, and the mechanism of which is easily accessible for repair. See illustration.

359,313. Electric Torpedo Boat; H. M. Bennett, Bournemouth, England. Application filed Feb. 6, 1886. This torpedo is provided with electric propelling and steering mechanism.

359,328. Electric Lamp; Carl Seel, Charlottenburg, Prussia, Germany. Application filed Jan. 11, 1886. This is a device for joining the carbon filaments to the leading-in wires.

359,338. Apparatus for Testing Electric Circuits; A. D. Wheeler, Hyde Park, Mass., Assignor to the American Automatic Fire-Alarm Association, Portland, Me. Application filed Sept. 11, 1886. This is an apparatus whereby circuits, particularly those in which thermostatic alarms are placed, may be tested frequently and quickly, and secure a record to show which, if any, is inoperative.

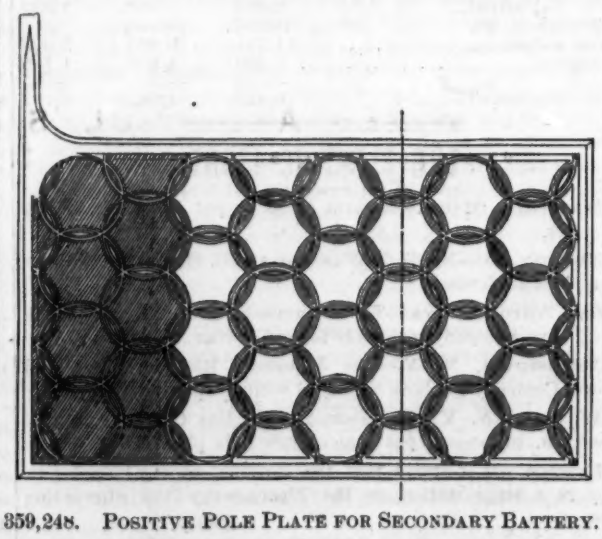
359,356. Telephone Switch; C. A. Hitchcock, North East, Pa., Assignor of three-fourths to Wm. Burnley, of same place, Samuel A. Davenport, of Erie, and Lewis F. Watson, of Warren, Pa. Application filed Dec. 15, 1886. Structural details relating to the ordinary hook lever for telephones are the object of this invention.



359,260. COMBINED PUSH BUTTON AND THERMOSTAT.

359,371. Railway Crossing Alarm; S. P. Van Nort, Manchester, Mo. Application filed March 12, 1886. This is a device whereby an alarm is sounded to warn persons at a crossing of the approach of a train.

359,392. Electrical Apparatus for Regulating Temperature; C. W. Johnson, Holyoke, Mass. Application filed Dec. 13, 1886. Devices are employed for operating the valves and dampers of heating apparatus through the variations of thermostats.



359,248. POSITIVE POLE PLATE FOR SECONDARY BATTERY.

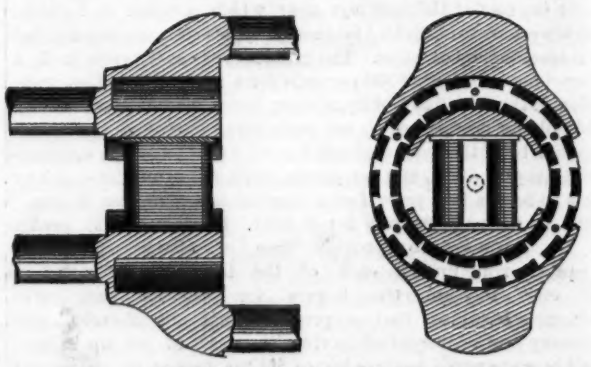
359,420. Electric Motor; E. P. Clark, Assignor to Ann E. Applegate and James H. Seymour, all of New York City. Application filed Nov. 23, 1886. A ring armature is provided with both internal and external teeth or projections, those on the inside being narrowed so as to admit of the proper winding of the ring. See illustration.

359,492. Telephone Cabinet; C. Balloch, New York N. Y. Application filed April 7, 1886. This cabinet is built with walls constructed of some non-conductor of sound. They are also made up of several layers which are separated from each other by air spaces.

359,506. Cautery Electrode and Shield; D. H. Goodwillie, New York, N. Y. Application filed Aug. 13, 1886. The object is to so construct the electrode and to so shield it that it can be introduced into and used to cauterize any part of the body without doing injury to the surrounding parts.

359,512. Railway Signal; M. W. Long, Harrisburg, Pa., Application filed May 26, 1886. This is a device located beside the track consisting, generally, of a generator and suitable connections to operate a signal to indicate the approach of a train. The mechanism is operated by the car wheels.

359,540. Electrical Pneumatic Dispatch Tube; J. F. McLaughlin, Philadelphia, Pa. Application filed Nov. 8, 1886.



359,429. ELECTRIC MOTOR.

Electricity is utilized for signaling and for operating the valve in pneumatic dispatch tubes.

359,552. Electric Igniter for Gas Engines; N. C. Bassett, Chicago, Ill., Assignor to W. E. Hale, of same place. Application filed June 3, 1886. The coils of a magneto-electric generator are mounted upon a stationary part of the engine and the armature is mounted upon a moving portion of the same. A circuit breaker is connected with the generator.

359,575. Police Telegraph System; J. F. Mehren and W. Carroll, Chicago, Ill., Assignors to the Police Telephone and Signal Company, of same place. Application filed Aug. 24, 1886. The object is to so arrange the system that a cross or ground connection on any line leading to the central office will not seriously impair the transmission of speech over such line.

359,581. Druggist Alarm; M. Toulmin, Baltimore, Md. Application filed Dec. 20, 1886. Devices are employed whereby the removal of a bottle or box, containing poison, from its accustomed place will cause a sign indicating poison to be presented and will close an electric circuit and cause the ringing of an alarm.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.